the OIL AND GAS JOURNAL

MARCH 11, 1957

Natural Gas...

Gas Pipelining

A SPECIAL SECTION FEATURING . . .

- What's ahead for gas
- Satellite stations
- Centrifugal compressors
- How long reserves will last

. . . starts page 119

Also- WALL MAP of U.S. Crude, Products, and Natural-Gas Pipelines

New Recovery Idea

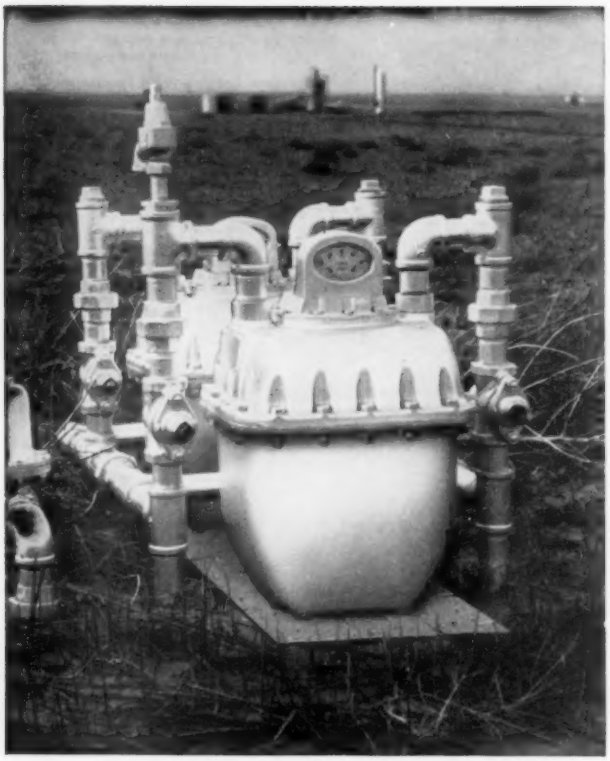
. . . looks too good to be true

p. 96

Washington Report

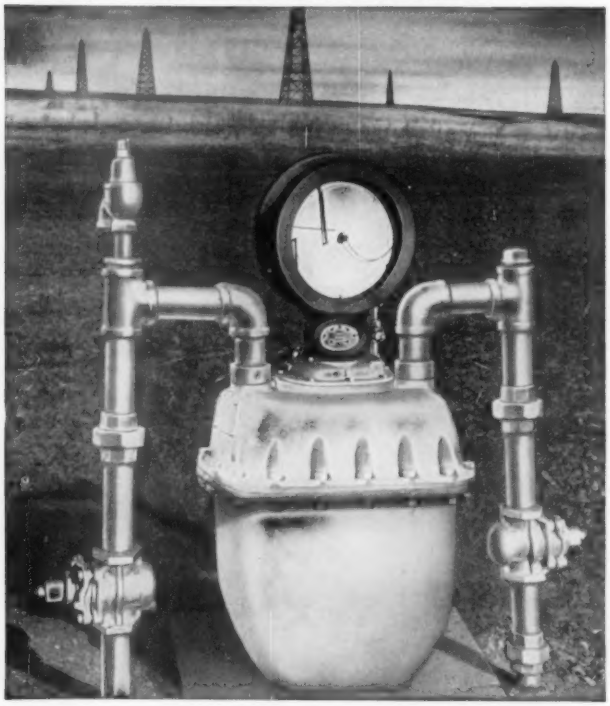
. . . what committees deal with oil

p. 104



(ABOVE) Installation of two Rockwell "800" meters in West Texas field with manifold controlled by Rockwell-Nordstrom valves.

(BELOW) Rockwell "800" meter with Combined Record Gauge measuring 75 lb gas in Kansas field. The valves are Rockwell-Nordstrom.



Recommended installation is off the ground and away from alkaline soil.

Portable, Corrosion Resistant Rockwell Aluminum Meters

MEASURE FIELD GAS

at up to 100 lb. working pressure

The Rockwell "800" is "made-to-measure" for gas sold or used on the lease. It weighs only 63 lbs, so is readily portable. The sturdy aluminum outer case withstands weathering and takes bumps and knocks in stride. There's a generous capacity rating of 1600 cfh at 4 oz inlet. This can be materially increased by measuring gas at higher pressures . . . up to 100 psi. Corrections for volume at high pressures are available with either a Rockwell Emcorector or a Combined Record Gauge. Write for full details.

Use For All These Field Applications:

- LEASE ACCOUNTING
- INTER-COMPANY REPORTS
- INTRA-COMPANY SALES
- PIPE LINE TAPS
- FIELD PROCESSING
- IRRIGATION FUEL SERVICE

YOU CAN RELY ON ROCKWELL

ROCKWELL MANUFACTURING COMPANY

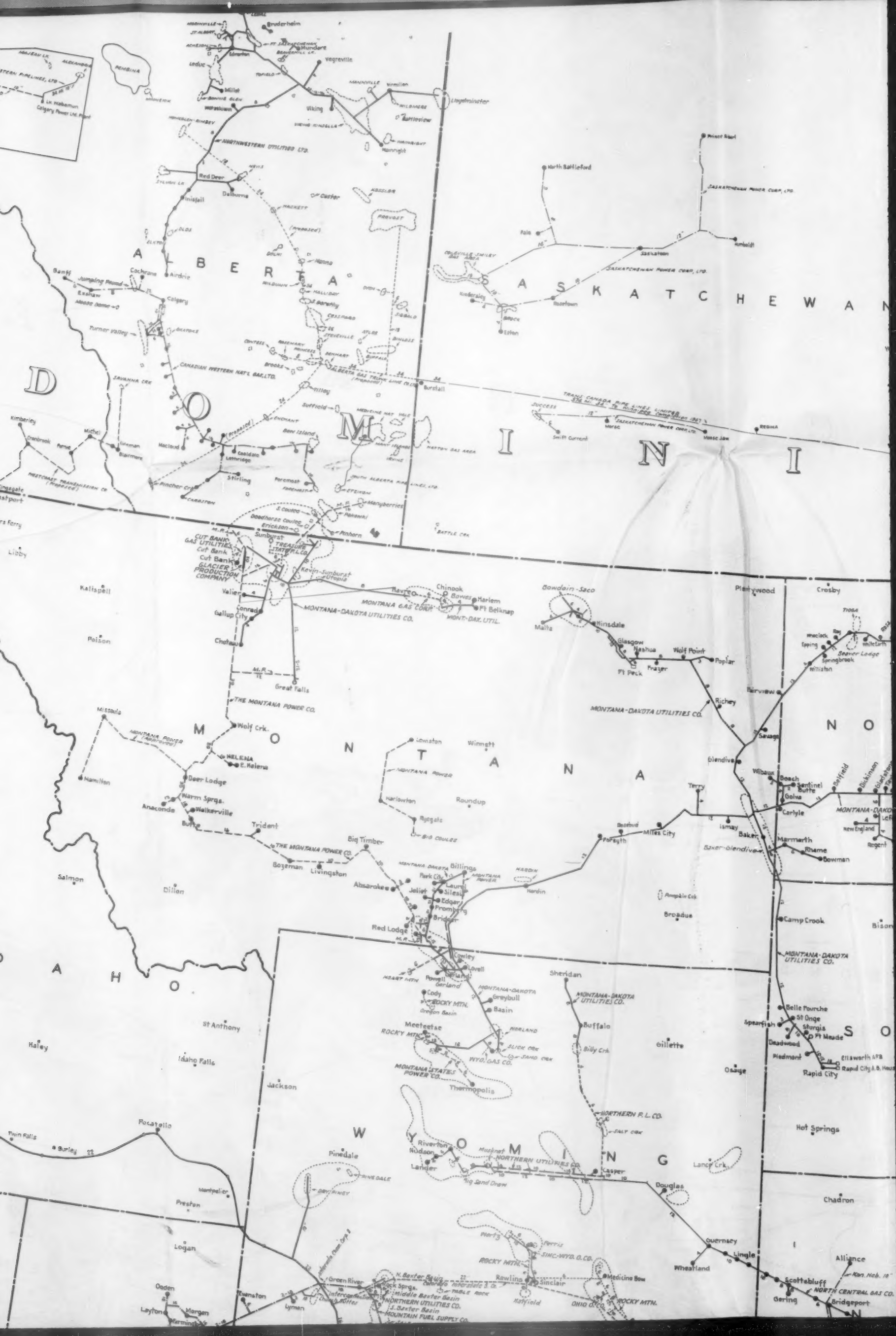
PITTSBURGH 8, PA. Atlanta Boston Charlotte Chicago Dallas Denver Houston Los Angeles Midland, Tex. New Orleans New York N. Kansas City Philadelphia Pittsburgh San Francisco Seattle Shreveport Tulsa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Toronto, Ontario

ROCKWELL "800" Aluminum GAS METER

THE OIL AN

INSERT "A"
INSERT "B"
BRITISH COLUMBIA
WASHINGTON
OREGON
IDAHO
CALIFORNIA
PACIFIC
Vancouver I.
Victoria
Vancouver
Portland
SEATTLE
Tacoma
OLYMPIA
SALEM
Eugene
Roseburg
Medford
Klamath Falls
Lakeview
Crescent City
Redding
Eureka
Arcata
Fort Bragg
Ukiah
Chico
Oroville
Alturas
McDermitt
Winnemucca
Gerlach
Lovelocks
Elko
Wells
Rome
Silver City
Idaho City
BOISE
Payette
Ontario
Canyon City
Baker
La Grande
Enterprise
Grangeville
Pendleton
The Dalles
Lyle
Hood River
Washougal
Tillamook
Aberdeen
Chehalis
Centralia
Longview
Kelso
Bellingham
Anacortes
Port Townsend
Concrete
Sumas
Aldergrove
Abbotsford
Hope
Princeton
Merritt
Kamloops
Savona
Salmon Arm
Vernon
Kelowna
Summerland
Penticton
Osoyoos
Oliver
Grand Forks
Trail
Nelson
Kimberley
Cranbrook
Fernie
Creston
Castlegar
Kingsgate
Boundary
Metaline Falls
Newport
Sandpoint
Bonners Ferry
Libby
Coeur d'Alene
Spokane
Cheney
Colfax
Pullman
Moscow
Potlatch
Lewiston
Clarkston
Dayton
Walla Walla
Hedges
Prosser
Kennewick
Richland
Pasco
Yakima
Ellensburg
Moses Lake
Grand Coulee
Chelan
Wenatchee
Omak
Okanogan
Oroville
Republic
Colville
Chewelah
Deer Park
Malaga
Rock Island
Issaquah
Renton
Aiderwood Manor
Seattle
Tacoma
Chico Crk
Chico
Willows
Corning
Red Bluff
Tehama
Tompkins Hill
Arcata
Eureka
Fort Bragg
Ukiah
Gold Beach
Jacksonville
Crescent City
Klamath Falls
Lakeview
Roseburg
Eugene
Albany
Corvallis
Lebanon
Dallas
Bend
Canyon City
Lime
Payette
Idaho City
Boise
Twin Falls
Silver City
Rome
McDermitt
Winnemucca
Gerlach
Lovelocks
Elko
Wells
Grangeville
Enterprise
La Grande
Baker
Pendleton
The Dalles
Lyle
Hood River
Washougal
Portland
Vancouver

ND GAS JOURNAL'S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Castor
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Drumheller
Strathmore
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Airdrie
Cochrane
Banff
Jumping Pound
Exshaw
Turner Valley
Okotoks
Brooks
Bassano
Oyen
Hilda
Medicine Hat
Redcliff
Suffield
Bow Island
Foremost
Pakowki
Manyberries
Pinhorn
Sunburst
Kevin-Sunburst
Utopia
Cut Bank
Valier
Conrad
Gallup City
Chateau
Great Falls
Havre
Chinook
Bowes
Harlem
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E. Helena
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Warm Spgs.
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Walkerville
Butte
Trident
Big Timber
Bozeman
Livingston
Billings
Park City
Laurel
Silesia
Joliet
Edgar
Frommberg
Bridger
Absarokee
Red Lodge
Lewiston
Winnett
Harlowton
Roundup
Ryegate
Big Coulee
Hardin
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Miles City
Baker
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Camp Crook
Broadus
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Buffalo
Billy Crk.
Gillette
Osage
Belle Fourche
St Onge
Sturgis
Ft Meade
Spearfish
Deadwood
Piedmont
Rapid City
Ellsworth AFB
Hot Springs
Douglas
Lance Crk.
Riverton
Hudson
Lander
Casper
Pinedale
Big Sand Draw
Medicine Bow
Rawlins
Sinclair
Hanna
Ferris
Hatfield
Chadron
Crawford
Guernsey
Lingle
Wheatland
Alliance
Scottsbluff
Gering
Bridgeport
NORTH CENTRAL GAS CO.
Green River
Rock Springs
Middle Baxter Basin
N. Baxter Basin
J. Baxter Basin
NORTHERN UTILITIES CO.
MOUNTAIN FUEL SUPPLY CO.
Evanston
Lyman
Ogden
Layton
Morgan
Kemmerer
Montpelier
Preston
Logan
Soda Springs
Pocatello
Twin Falls
Burley
Rupert
Idaho Falls
St Anthony
Jackson
Salmon
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Kalispell
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Fairview
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Savage
Sidney
Lambert
Circle
Culbertson
Scobey
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Whitetail
Springbrook
Williston
Beaver Lodge
Epping
Wheelock
Ray
Tioga
Watford City
Killdeer
Dunn Center
Halliday
Dodge
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Beulah
Zap
Hebron
Glen Ullin
Hebron
Mandan
Bismarck
Wilton
Underwood
Washburn
Garrison
Riverdale
Max
Ryder
Minot
Velva
Towner
Granville
Sherwood
Mohall
Kenmare
Bowbells
Crosby
Stanley
Parshall
New Town

NAL'S MAP OF N

The Pas
MANITOBA
Dauphin
Yorkton
Emerson
Baudette
Port Frances
International Falls
Kenora
Dryden
Portage La Prairie
Brandon
Cromer
Hallock
Grafton
Rugby
Devils Lake
Brand Park
Harvey
Carrington
Jamestown
Fargo
Moorhead
Bemidji
Grand Rapids
Hibbing
Brainerd
Sandstone
St Cloud
Wheaton
Britton
Eureka
McIntosh
Linton
La Moure
Wahpeton
Breckenridge
Aberdeen
Bison
Camp Crook
Gettysburg
Redfield
Watertown
Madison
Huron
Brookings
Redwood Falls
New Ulm
Mankato
Waseca
Fairmont
Austin
Albert Lea
Faribault
Northwood
Kensett
Manley
Mason City
Clarion
Belmond
Humboldt
Fort Dodge
Lake City
Spencer
Cherokee
Le Mars
Sioux City
Sioux Falls
Pipestone
Mitchell
Kadoka
Hot Springs
Pierre
Rapid City
Ellsworth AFB
Rapid City A.B. Housing
Osage
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Willmar
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Grantsburg
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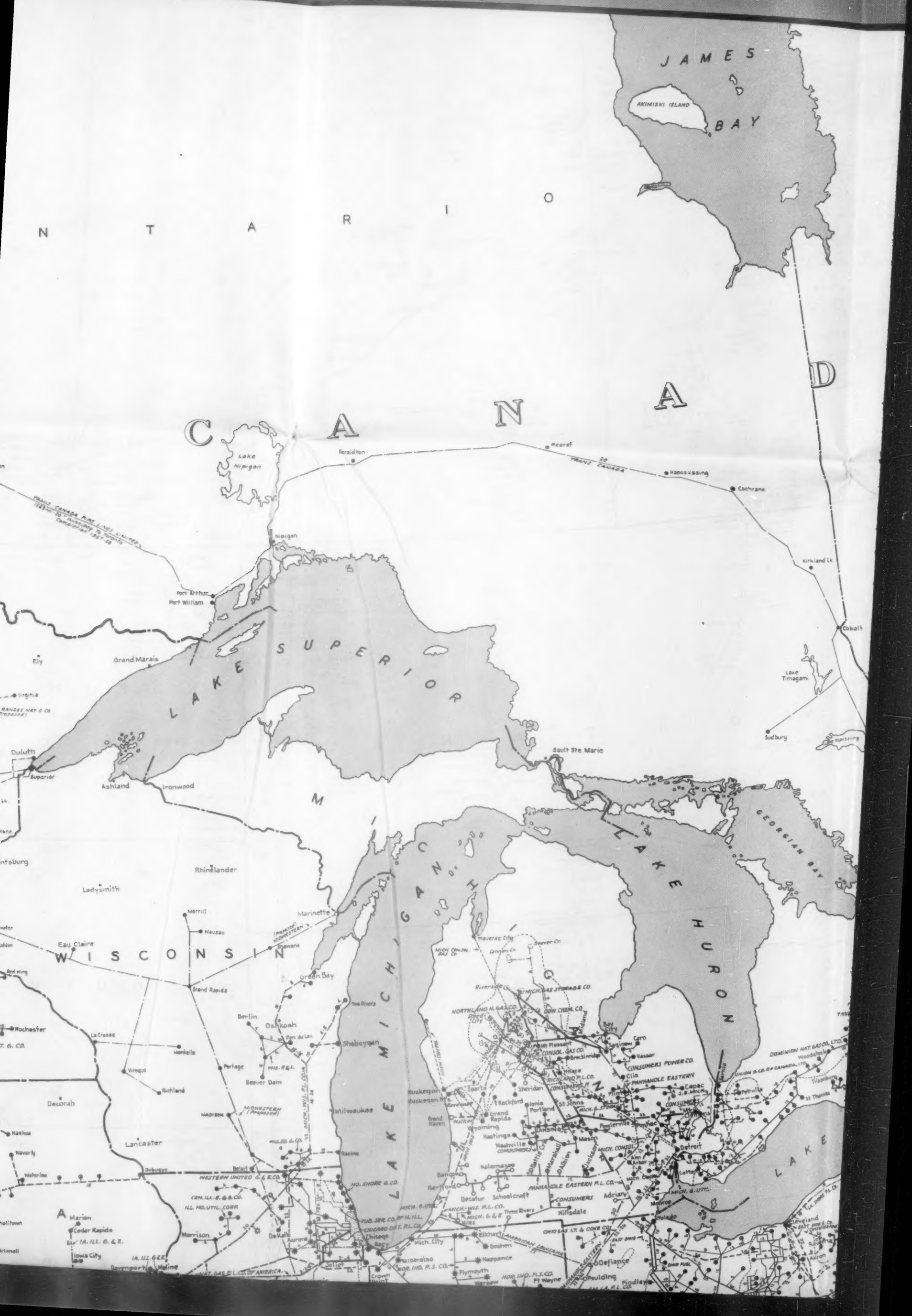
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
IOWA
NEBRASKA
MONTANA-DAKOTA UTILITIES CO.
NORTHERN NAT. G. CO.
NORTHERN NATURAL
MINNESOTA NAT. G. CO.
MINNEAPOLIS GAS LTG. CO.
YANKTON GAS CO.
NORTH CENTRAL GAS CO.
SASKATCHEWAN POWER CORP. LTD.

Natural-Gas P



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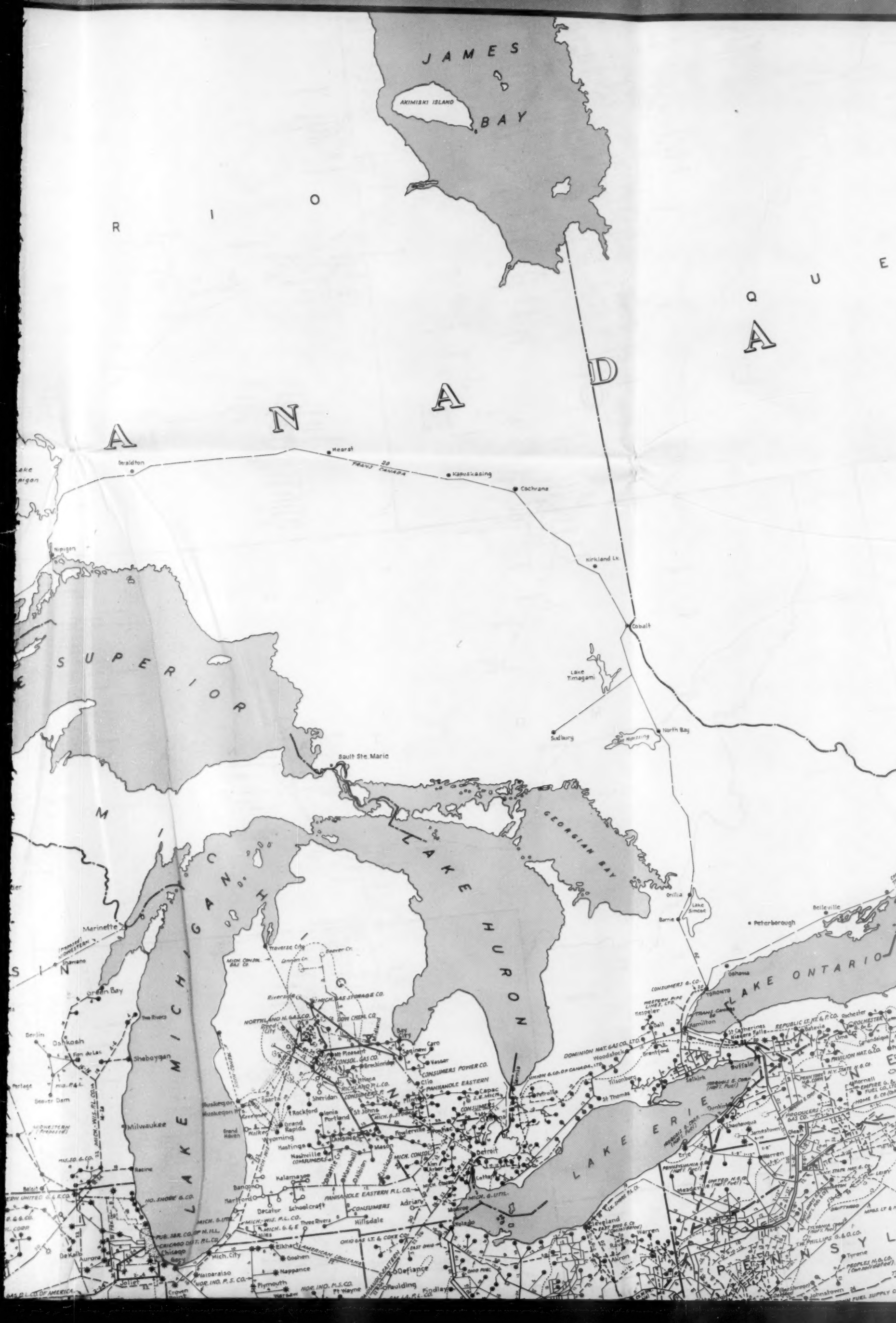

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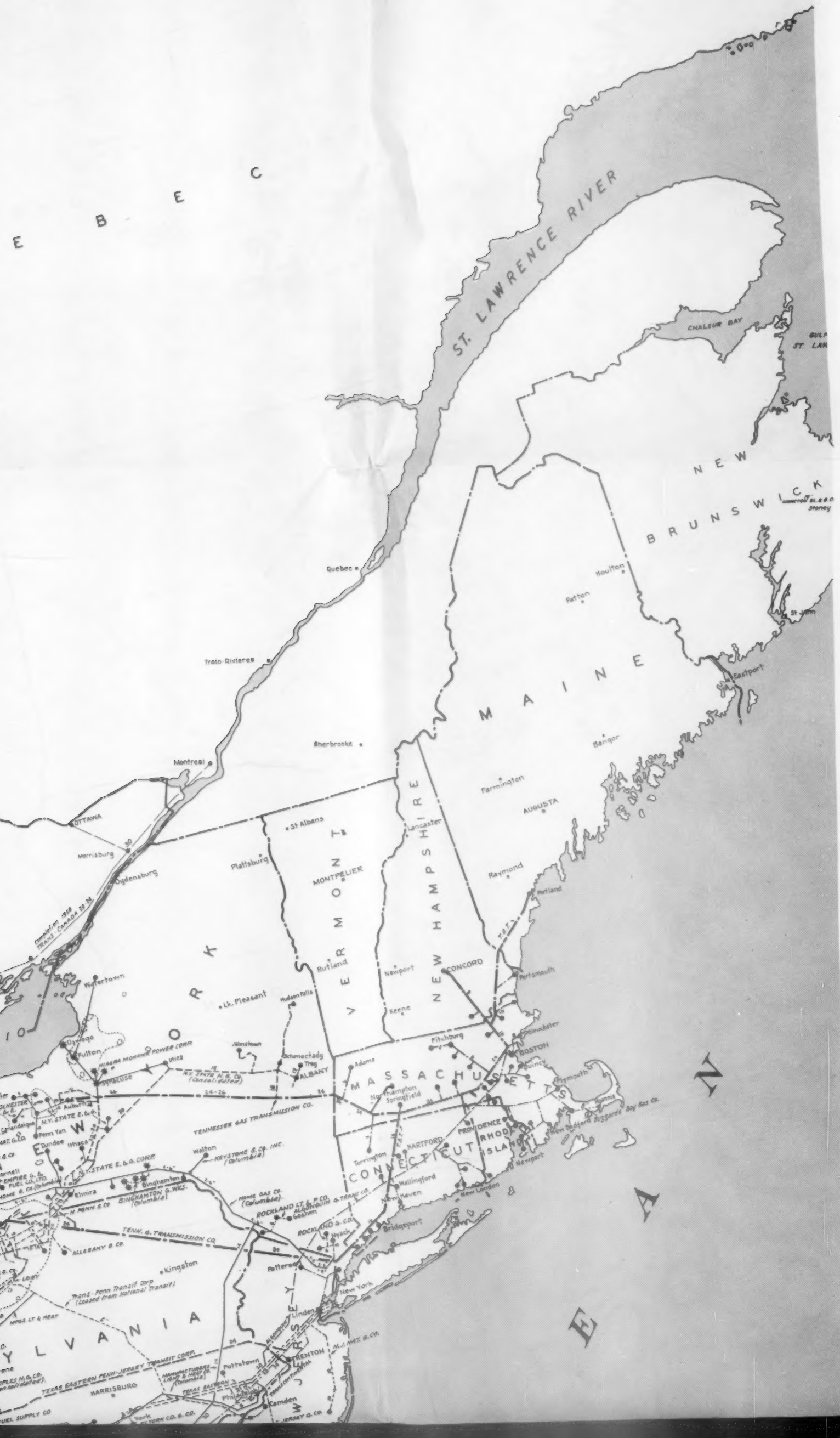
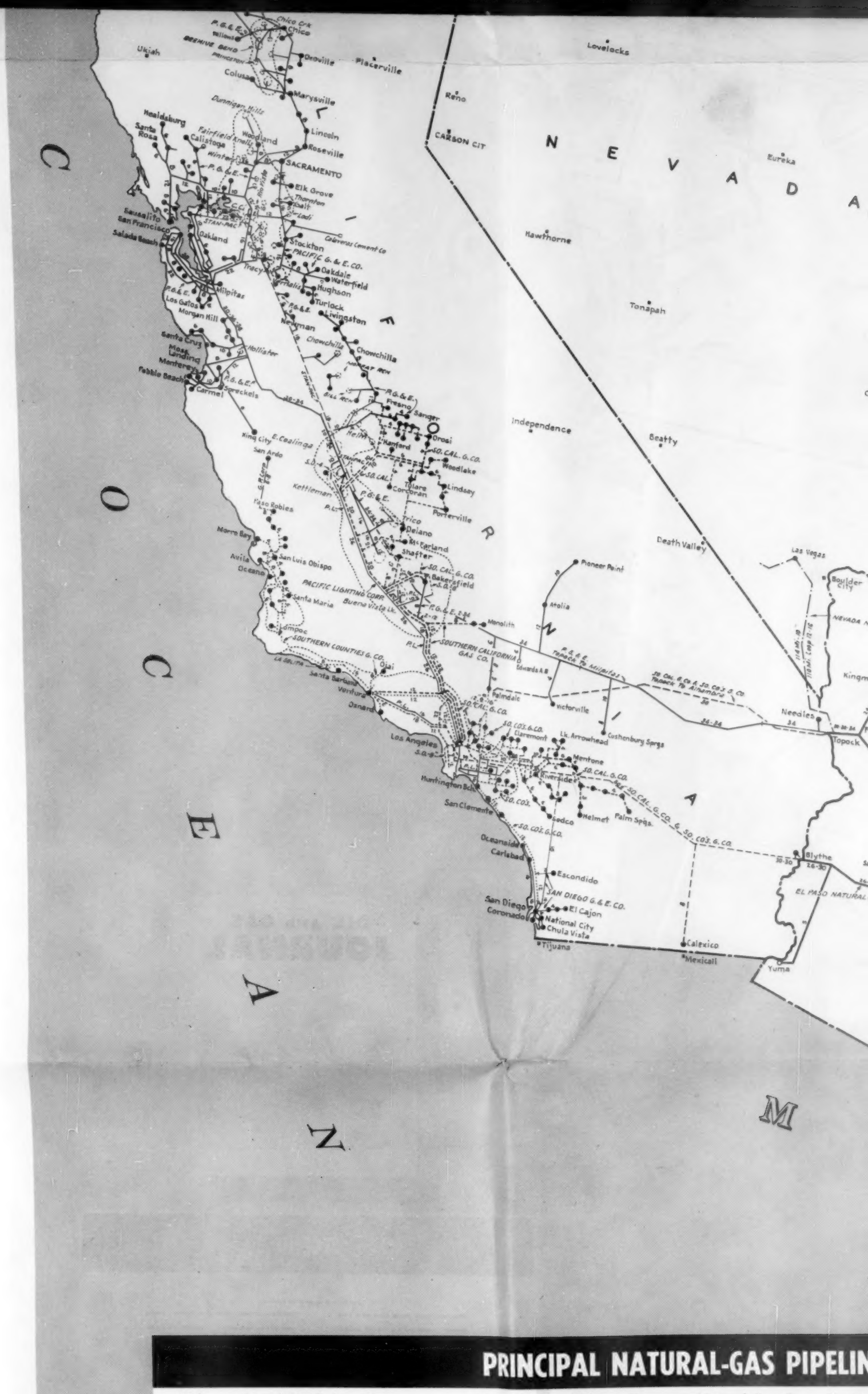

ST. LAWRENCE RIVER
CHALEUR BAY
NEW BRUNSWICK
Quebec
Trois-Rivieres
Montreal
Sherbrooke
Houlton
Patton
St John
Eastport
MAINE
Bangor
Farmington
AUGUSTA
Portland
Raymond
OTTAWA
Morrisburg
Ogdensburg
Plattsburg
St Albans
MONTPELIER
VERMONT
Lancaster
NEW HAMPSHIRE
Rutland
Newport
Keene
CONCORD
Portsmouth
Gloucester
Fitchburg
BOSTON
Quincy
Plymouth
Hyannis
Adams
Northampton
Springfield
MASSACHUSETTS
Watertown
Lk. Pleasant
Hudson Falls
Schenectady
Troy
ALBANY
Johnstown
Oswego
Fulton
Syracuse
Utica
NIAGARA MOHAWK POWER CORP
N.Y. STATE N.G. Co. (Contemplated)
TENNESSEE GAS TRANSMISSION CO.
N.Y. STATE E. & G. CORP
KEYSTONE G. Co. INC. (Columbia)
Walton
Binghamton
Elmira
Auburn
Penn Yan
Ithaca
Dundee
Cortland
Torrington
HARTFORD
PROVIDENCE
RHODE ISLAND
New Bedford
Buzzard's Bay Gas Co.
Newport
Wallingford
New Haven
New London
CONNECTICUT
Bridgeport
Stamford
Nyack
ROCKLAND G. Co.
ROCKLAND LT. & P. CO.
ALGONQUIN G. TRANS. CO.
Goshen
HOME GAS CO. (Columbia)
BINGHAMTON G. WKS. (Columbia)
N. PENN. G. Co.
TENN. G. TRANSMISSION CO.
ALLEGANY G. Co.
Patterson
New York
Linden
Kingston
Trans-Penn Transit Corp. (Leased from National Transit)
MPRS. LT. & HEAT
PENNSYLVANIA
NEW JERSEY
M.-J. NAT. G. Co.
TRENTON
Pottstown
Phoenixville
Camden
HARRISBURG
TEXAS EASTERN TRANSMISSION CORP.
TEXAS EASTERN
MANUFACTURERS LIGHT & HEAT Co. (Columbia)
TEXAS EASTERN TENN.-JERSEY TRANSIT CORP.
York
YORK CO. G. CO.
JERSEY G. Co.
Completion 1968
TRANS-CANADA
ATLANTIC OCEAN



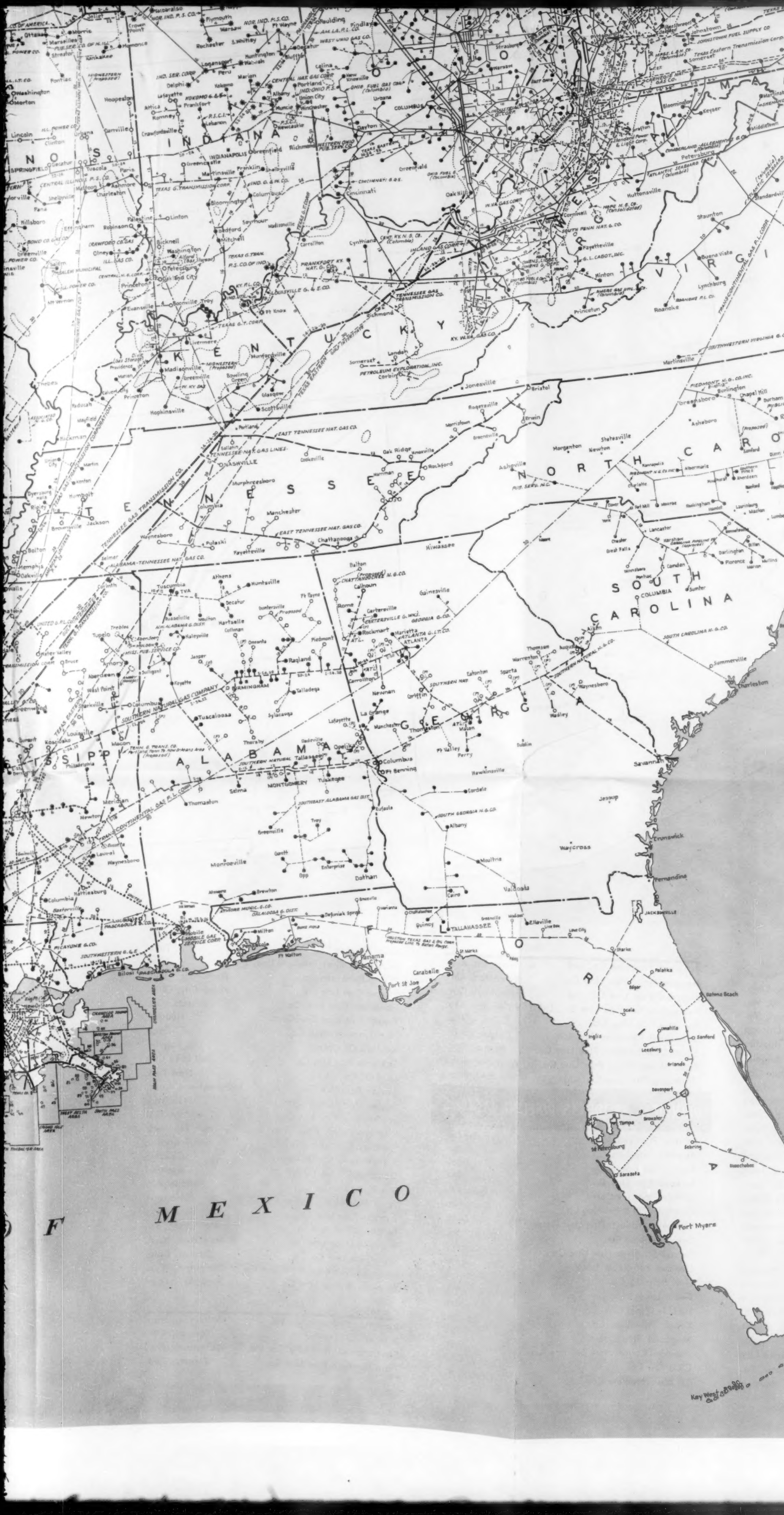
PRINCIPAL NATURAL-GAS PIPELIN

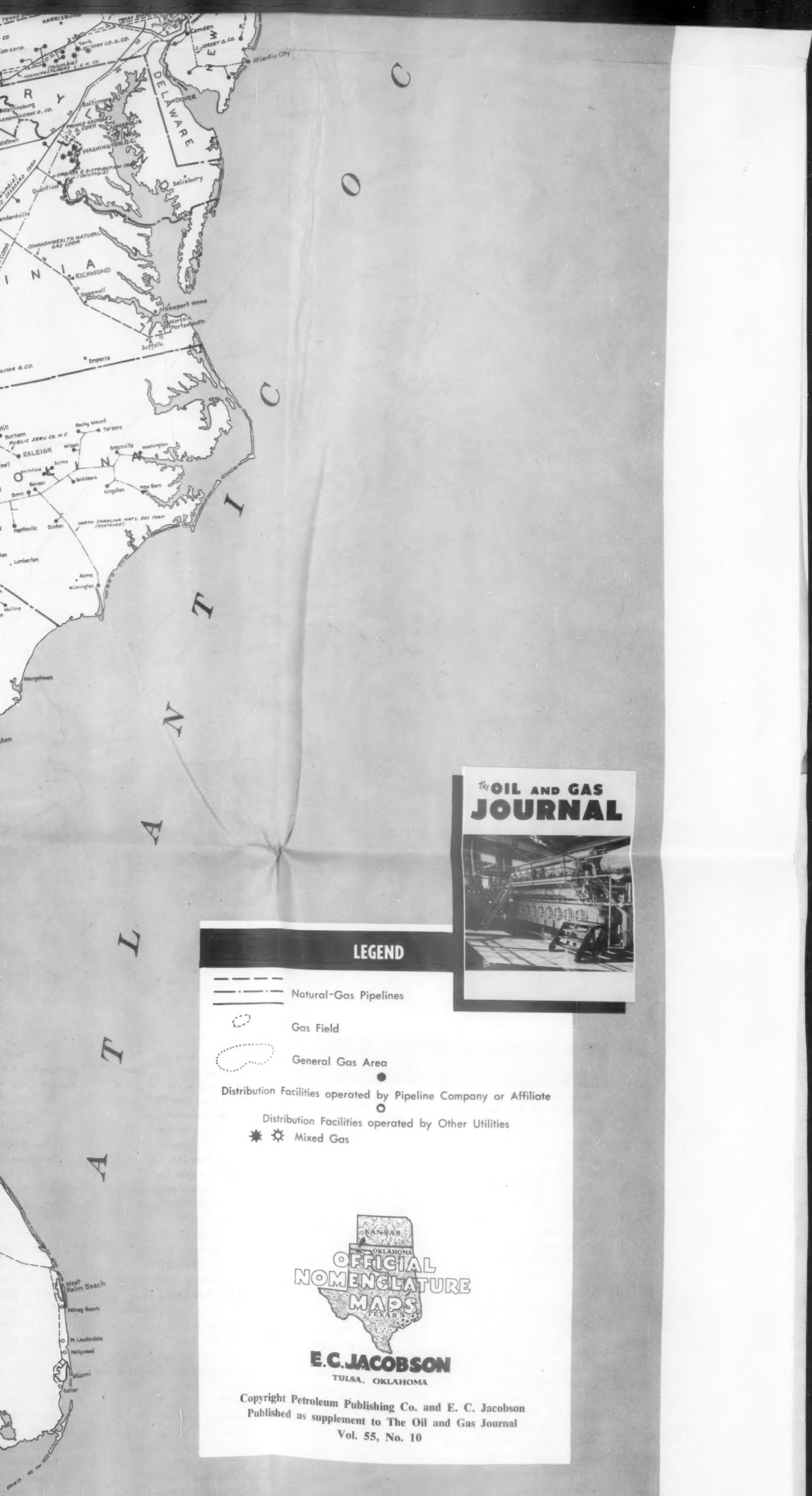
Michigan Consolidated Gas Co.	Detroit	Alabama-Tennessee Natural Gas Co.	Florenc
Michigan Wisconsin Pipe Line Co.	Detroit	Algonquin Gas Transmission Co.	
Mississippi Valley Gas Co.	Jackson, Miss.	American Louisiana Pipe Line Co.	
Mississippi River Fuel Corp.	St. Louis	Arkansas Louisiana Gas Co.	Shr
Montana-Dakota Utilities Co.	Minneapolis	Cabot Carbon Co.	Pamp
Montana Power Co.	Butte, Mont.	Carnegie Natural Gas Co.	Pi
Mountain Fuel Supply Co.	Salt Lake City	Chicago District Pipeline Co.	
Natural Gas Pipeline Co. of America	Chicago	Cities Service Gas Co.	Oklaho
New York State Natural Gas Corp.	Pittsburgh	Colorado Interstate Gas Co.	Colorado
Northern Natural Gas Co.	Omaha	Colorado-Wyoming Gas Co.	
Ohio Fuel Gas Co.	Columbus	Columbia Gas System, Inc.	N
Oklahoma Natural Gas Co.	Tulsa	Consolidated Gas Utilities Corp.	Oklaho
Olin Gas Transmission Corp.	Monroe, La.	East Ohio Gas Co.	C
Pacific Gas & Electric Co.	San Francisco	East Tennessee Natural Gas Co.	
Pacific Northwest Pipeline Corp.	Salt Lake City	El Paso Natural Gas Co.	
Panhandle Eastern Pipe Line Co.	Kansas City, Mo.	Empire Southern Gas Co.	Fo
Peoples Natural Gas Co.	Pittsburgh	Gulf Interstate Gas Co.	
Permian Basin Pipeline Co.	Omaha	Hope Natural Gas Co.	Clarksburg
Pioneer Natural Gas Co.	Amarillo, Tex.	Houston Pipe Line Co.	
Rio Grande Valley Gas Co.	Brownsville, Tex.	Kansas-Nebraska Natural Gas Co.	Phillipsbu
Southern California Gas Co.	Los Angeles	Kansas Power & Light Co.	Tope
Southern Counties Gas Co.	Los Angeles	Kentucky West Virginia Gas Co.	Ash
Southern Natural Gas Co.	Birmingham, Ala.	Lone Star Gas Co.	

UTAH
COLORADO
ARIZONA
NEW MEXICO
TEXAS
SALT LAKE CITY
MOUNTAIN FUEL SUPPLY CO.
Layton
Morgan
Kemmerer
Centerville
Bountiful
Magna
Tooele
Sandy
Provo
Pleasant Grove
Spanish Fork
Eureka
Utah Natural Gas Co.
Vernal
BLUE BELL
Craig
ROCKY MTN.
Walden
Ft Collins
Greeley
Berthoud
Longmont
Ft Lupton
Brighton
Boulder
Golden
DENVER
Ft Logan
Littleton
Leadville
Limon
Colorado Springs
COLORADO INTERSTATE GAS
Canon City
Pueblo
Ordway
Rocky Ford
Manzanola
Las Animas
Trinidad
Raton
Clayton
Fillmore
Milford
Escalante
Monticello
Moab
Grand Jct.
Gunnison
Uravan
Nucla
PACIFIC NORTHWEST PIPELINE CORP.
Dove Crk
Cortez
Mc Elmo
PT LOOKOUT
Durango
Ignacio
Allison
Barker
Aztec
Farmington
SAN JUAN BASIN
Gallup
Cuba
SOUTHERN UNION
SO. UNION
Espanola
Los Alimos
U.S.GOVT.
SANTA FE
SOUTHERN UNION G. CO.
Bernalillo
Albuquerque
Isleta
Los Lunas
Belen
Mountainair
Socorro
Conchas Dam
Tucumcari
SOUTHERN UNION GAS CO.
Roswell
Dexter
Hagerman
Lk. Arthur
Artesia
Carlsbad
Loving
Holloman Air Base
Alamogordo
Las Cruces
LAS CRUCES MUNICIPAL
Deming
Silver City
Ft Bayard
Hurley
Lordsburg
El Paso
EL PASO NATURAL G. CO.
LEA CO. GAS CO.
Fabens
Van Horn
Marfa
Pecos
Chihuahua
PEMEX (Proposed)
Jimenez
Phoenix
Mesa
Miami
Globe
Superior
Hayden
San Manuel Copper Corp.
Ariz Cement
Tucson
Benson
Apache Powder
Safford
Morenci
Clifton
Ajo
Nogales
Ft Huachuca
Bisbee
Douglas
Cananea
Kanab
St George
Prescott
Flagstaff
Williams
Winslow
Holbrook
Leupp
Dilkan
Indian Wells
Seligman
Chino
Franconia
Salome
St Johns
CENTRAL ARIZ. L. & R. CO.
EL PASO NATURAL GAS CO.
Middle Baxter Basin
NORTHERN UTILITIES CO.
S. Baxter Basin
MOUNTAIN FUEL SUPPLY CO.
SALT WELLS
Hiawatha
Powder Wash
Rangely
WHITE RIVER
Douglas Crk
PICEANCE
S. PICEANCE
Thin Buttes
Hunters Cy
HIGHLINE CANAL
Southern Cy
Petes Pt
San Arroyo
Bar-X
Disco
N. Salt Valley
Saber
Jobs Valley
Flat Cy
Clear Cr
Price
Castle Dale
Ruffield
OHIO OIL CO.
ROCKY MTN.
Laramie
Ft Warren
CHEYENNE
Colorado Interstate G. Co.
COLORADO-WYOMING G. CO.
Kimball
Ft Morgan
Lee
Keensburg
Baldwin
Natural
Gerin
Limon
Rocky Ford
Holly
Lamar
Eads
Kiowa
Colorado City
Big Spring
Midland
Odessa
Pecos
Monahans
Wink
Kermit
Jal
Hobbs
Lovington
Artesia
Am. Petrofina
Eunice
Langlie
Jal
Tatum
Seminole
Andrews
Hobbs
Lea
Eddy
Chaves
Roosevelt
Curry
Quay
Harding
Union
Colfax
Mora
San Miguel
Guadalupe
Torrance
Lincoln
Otero
Sierra
Dona Ana
Luna
Hidalgo
Grant
Catron
Socorro
Valencia
Cibola
McKinley
Sandoval
Rio Arriba
Taos
Colfax
Union
Harding
Quay
Curry
Roosevelt
Lea
Eddy
Chaves

NEBRASKA
COLORADO
KANSAS
OKLAHOMA
NEW MEXICO
TEXAS
Brewster
Burwell
Norfolk
Gering
Bridgeport
North Platte
Ogallala
Kimball
Broken Bow
Grand Island
York
Lincoln
Omaha
Hastings
Kearney
Holbrook
McCook
Superior
Nelson
Fairbury
Beatrice
Nebraska City
Auburn
Humboldt
Falls City
Pawnee City
Wilber
Crete
Friend
Geneva
Fairmont
Blue Springs
Sabetha
Seneca
Frankfort
Onaga
Holton
St Marys
Manhattan
TOPEKA
Jct. City
Council Grove
Salina
Minneapolis
Abilene
Ellsworth
Lincoln
Beloit
Glasco
Osborne
Stockton
Phillipsburg
Formoso
Scandia
Smith Center
Almena
Oberlin
Atwood
St Francis
Colby
Goodland
Hill City
Wakeeney
Luray
Russell
Barnard
Lucas
Wilson
Ellsworth
Kanopolis
Berrenton
Marquette
McCracken
Ness City
Dighton
Horace
Garden City
Syracuse
Lakin
Kearny
Hugoton
Satanta
Sublette
Liberal
Meade
Dodge City
Cimarron
Ingalls
Minneola
Ford
Spearville
Kinsley
Offerle
Larned
Great Bend
Hutchinson
Zenith
Peabody
Marion
Madison
Eureka
Moline
Howard
Sedan
Coffeyville
Independence
Parsons
Chanute
Iola
Yates Center
Fredonia
Neodesha
Cherryvale
Caney
Dewey
Bartlesville
Nowata
Collinsville
Skiatook
Sapulpa
Tulsa
Pawhuska
Bristow
Kiefer
Jenks
Okmulgee
Henryetta
Holdenville
Wewoka
Seminole
Shawnee
Tecumseh
Konawa
Ada
Ardmore
Marietta
Madill
Durant
Caddo
Tishomingo
Atoka
Coalgate
Wilburton
Poteau
Heavener
Talihina
Hugo
Idabel
Broken Bow
Valliant
Antlers
Clayton
Stratford
Booker
Dumas
Canadian
Pampa
Borger
Amarillo
Panhandle
Cliffside
Bureau Of Mines
Canyon
Hereford
Friona
Bovina
Clovis
Portales
Tulia
Silverton
Quitaque
Kress
Plainview
Lockney
Floydada
Center
Petersburg
Abernathy
Crosbyton
Lubbock
Tahoka
Post
Brownfield
Seagraves
Seminole
Lamesa
Slaton
Ralls
Plains
Meadow
Lovington
Hobbs
Eunice
Jal
Monument
Hobbs
Artesia
Lk. Arthur
Dexter
Roswell
Carlsbad
Loving
Malaga
Pierce Canyon
Whites City
Fabens
El Paso
Van Horn
Marfa
Sanderson
Fort Stockton
Pecos
Crane
Big Spring
Stanton
Midland
Odessa
Andrews
McCamey
Iraan
Sheffield
Ozona
Sonora
Eldorado
Mertzon
Barnhart
Big Lake
Reagan Co.
Upton Co.
Crockett Co.
Pecos Co.
Terrell Co.
Val Verde Co.
Edwards Co.
Kimble Co.
Mason
Llano
Burnet
Lampasas
Gatesville
Temple
Killeen
Belton
Georgetown
Round Rock
Austin
Taylor
Giddings
La Grange
San Marcos
Lockhart
Luling
Seguin
Bandera
Kerrville
Hondo
Pleasanton
Poteet
Jourdanton
Campbellton
Charlotte
Uvalde
Cow Hill
Chittam
Eagle Pass
Carrizo Springs
Del Rio
Rosita
Chihuahua
Jimenez
Torreon
Monterrey
Saltillo
Matamoros
Brownsville
Harlingen
San Benito
Raymondville
Mercedes
Weslaco
Edinburg
McAllen
Mission
Pharr
Roma
Los Saenz
Rio Grande City
Lopeno
Lobo
Zapata
Laredo
Nuevo Laredo
Retamia
Hebbronville
La Gloria
Alice
Kingsville
Corpus Christi
Sinton
Refugio
Woodsboro
Bayside
Port Lavaca
Victoria
Cuero
Yoakum
Hallettsville
Shiner
Luling
Lockhart
San Marcos
Seguin
Gonzales
Flatonia
Schulenburg
La Grange
Giddings
Bastrop
Elgin
Taylor
Georgetown
Round Rock
Austin
Marble Falls
Llano
Burnet
Lampasas
Gatesville
Temple
Killeen
Belton
Rosebud
Cameron
Rockdale
Calvert
Hearne
Bryan
College Sta.
Navasota
Madisonville
Huntsville
Conroe
Willis
Montgomery
Cleburne
Ennis
Milford
Frost
Streetman
Teague
Corsicana
Waxahachie
Dallas
Fort Worth
Terrell
Greenville
Commerce
Paris
Sherman
Denison
Gainesville
Tioga
Celina
Decatur
Bridgeport
Jacksboro
Graham
Olney
Archer City
Wichita Falls
Henrietta
Electra
Vernon
Quanah
Childress
Paducah
Crowell
Benjamin
Seymour
Goree
Rochester
Haskell
Rule
Throckmorton
Albany
Breckenridge
Stamford
Hamlin
Anson
Roby
Sweetwater
Colorado
Loraine
Snyder
Ira
Roscoe
Trent
Merkel
Tuscola
Abilene
Sweet Water
Eastland
Cisco
Ranger
Baird
Clyde
Winters
Ballinger
Coleman
Brownwood
Comanche
De Leon
Dublin
Stephenville
Hamilton
Gorman
Duffau
Morgan
Meridian
Clifton
Valley Mills
McGregor
Waco
Groesbeck
Buffalo
Marlin
Rosebud
Cameron
Rockdale
Georgetown
Taylor
Granger
Hutto
Elgin
Bastrop
Giddings
La Grange
San Marcos
Lockhart
Luling
Seguin
Gonzales
Flatonia
Schulenburg
Hallettsville
Yoakum
Cuero
Victoria
Port Lavaca
Refugio
Woodsboro
Bayside
Sinton
Corpus Christi
Kingsville
Alice
Falfurrias
Hebbronville
Raymondville
Harlingen
San Benito
Brownsville
Matamoros
Weslaco
Edinburg
McAllen
Mission
Pharr
Roma
Los Saenz
Rio Grande City
Lopeno
Lobo
Zapata
Laredo
Nuevo Laredo
Retamia
Del Rio
Uvalde
Eagle Pass
Carrizo Springs
Rosita
Chihuahua
Jimenez
Torreon
Monterrey
Saltillo
Sabinas
Piedras Negras
Ojinaga
Presidio
Marfa
Van Horn
Sierra Blanca
Fort Hancock
Clint
Socorro
Isleta
Los Lunas
Belen
Albuquerque
Bernalillo
Tucumcari
Conchas Dam
Las Vegas
Santa Fe
Los Alamos
Espanola
Taos
Raton
Trinidad
Walsenburg
La Junta
Lamar
Springfield
Manter
Syracuse
Garden City
Scott City
Leoti
Tribune
Goodland
Colby
Oakley
Hays
Russell
Salina
Abilene
Junction
Kerrville
Fredericksburg
Boerne
San Antonio
New Braunfels
Seguin
Luling
Lockhart
San Marcos
Bandera
Hondo
Pleasanton
Poteet
Jourdanton
Campbellton
Charlotte
Uvalde
Cow Hill
Chittam
Eagle Pass
Carrizo Springs
Del Rio

ILLINOIS
INDIANA
MISSOURI
KENTUCKY
ARKANSAS
MISSISSIPPI
ALABAMA
LOUISIANA
TENNESSEE
OKLAHOMA
GULF OF MEXICO
Audubon
Harlan
Walnut
Avoca
Atlantic
Griswold
Council Bluffs
Glenwood
Red Oak
Shenandoah
Auburn
Humboldt
Falls City
Nebraska City
Maryville
Trenton
St Joseph
Horton
Holton
Valley Falls
Marys
TOPEKA
Lawrence
Kansas City
Liberty
Excelsior Spgs.
Carrollton
Lexington
Marshall
Sweet Spgs
Fayette
Sedalia
Tipton
Ottawa
Harrisonville
Clinton
Butler
Burlington
Madison
Chanute
Girard
Parsons
Coffeyville
Cherryvale
Independence
Iola
Yates Center
Neosho
Miami
Nowata
Vinita
Pryor
Claremore
Collinsville
Bentonville
Rogers
Springdale
Siloam Spgs.
Fayetteville
Gentry
Muskogee
Sallisaw
Stigler
Spiro
Eufaula
Atoka
Antlers
Hugo
Broken Bow
Paris
Clarksville
Pecan Gap
Enloe
Deport
Talco
Mt Vernon
Mt Pleasant
Sulphur Spgs
Greenville
Pittsburg
Winnsboro
Terrell
Gilmer
Quitman
Mineola
Chapel Hill
Tyler
Athens
Cayuga
Palestine
Rusk
Jacksonville
Troup
Overton
Longview
Kilgore
Henderson
Gladewater
Carthage
Center
Nacogdoches
Lufkin
Crockett
Groveton
Jasper
Madisonville
Huntsville
Navasota
Conroe
Tomball
Katy
Houston
Pasadena
Baytown
Texas City
Galveston
Bay City
Palacios
Freeport
Angleton
Alvin
Pearland
Sugar Land
Richmond
Rosenberg
Wharton
Columbus
La Grange
Bellville
Brenham
Hempstead
Waller
Tomball
Cleveland
Liberty
Dayton
Anahuac
Winnie
Port Arthur
Orange
Beaumont
Port Neches
Nederland
Groves
Sabine Pass
Sabine Lake
Lake Charles
Sulphur
DeQuincy
Vinton
Westlake
Jennings
Welsh
Crowley
Rayne
Abbeville
Kaplan
Erath
Delcambre
New Iberia
Franklin
Morgan City
Houma
Thibodaux
Raceland
Lockport
Larose
Golden Meadow
Cut Off
Galliano
Lafourche
Grand Isle
Port Fourchon
Belle Pass
Leeville
Bayou Rigaud
Bayou Lafourche
Bayou Terrebonne
Bayou Black
Bayou Teche
Bayou Vermilion
Bayou Plaquemine
Bayou Sale
Bayou Boeuf
Bayou Cocodrie
Bayou Rapides
Bayou Lacombe
Bayou Liberty
Bayou Chinchuba
Bayou Bonfouca
Bayou Sauvage
Bayou Des Allemands
Bayou Des Familles
Bayou Des Acadiens
Bayou Des Cannes
Bayou Des Glaises
Bayou Des Lacs
Bayou Des Oies
Bayou Des Ecores
Bayou Des Ecores Rouges
Bayou Des Ecores Noires
Bayou Des Ecores Blanches
Bayou Des Ecores Jaunes
Bayou Des Ecores Vertes
Bayou Des Ecores Bleues
Bayou Des Ecores Grises
Bayou Des Ecores Violettes
Bayou Des Ecores Oranges
Bayou Des Ecores Roses
Bayou Des Ecores Marrons


INDIANA
OHIO
WEST VIRGINIA
KENTUCKY
TENNESSEE
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
FLORIDA
GULF OF MEXICO
Chicago
Gary
Joliet
Indianapolis
Columbus
Cincinnati
Dayton
Springfield
Evansville
Terre Haute
Fort Wayne
Toledo
Cleveland
Akron
Canton
Youngstown
Pittsburgh
Wheeling
Parkersburg
Huntington
Charleston
Ashland
Lexington
Louisville
Frankfort
Bowling Green
Paducah
Nashville
Knoxville
Chattanooga
Memphis
Jackson
Meridian
Hattiesburg
Gulfport
Biloxi
Mobile
Birmingham
Montgomery
Tuscaloosa
Selma
Atlanta
Macon
Columbus
Albany
Savannah
Augusta
Charleston
Columbia
Greenville
Asheville
Charlotte
Raleigh
Durham
Greensboro
Winston-Salem
Roanoke
Lynchburg
Richmond
Norfolk
Petersburg
Charlottesville
Staunton
Harrisburg
Pittsburgh
Erie
Buffalo
Rochester
Syracuse
Albany
Binghamton
Scranton
Wilkes-Barre
Allentown
Reading
Philadelphia
Trenton
Atlantic City
Wilmington
Baltimore
Washington
Annapolis
Dover
Salisbury
Ocean City
Cape May
Jacksonville
Tallahassee
Pensacola
Panama City
Tampa
St. Petersburg
Sarasota
Fort Myers
Orlando
Daytona Beach
Miami
Key West
Lake Michigan
Lake Erie
Lake Ontario
Lake Huron
Lake Superior
Lake Okeechobee
Gulf Stream
Appalachian Mountains
Blue Ridge Mountains
Great Smoky Mountains
Cumberland Mountains
Ohio River
Mississippi River
Tennessee River
Cumberland River
Kanawha River
Potomac River
Susquehanna River
Delaware River
Hudson River
Connecticut River
Merrimack River
Kennebec River
Penobscot River
Androscoggin River
Saco River
Piscataqua River
Thames River
Narragansett Bay
Long Island Sound
Chesapeake Bay
Delaware Bay
Cape Cod
Cape Hatteras
Cape Fear
Cape Lookout
Cape Romain
Cape Canaveral
Cape Florida
Cape Sable
Cape San Blas
Cape Fear
Cape Henry
Cape May
Cape Cod
Cape Ann
Cape Elizabeth
Cape Neddick
Cape Porpoise
Cape Small
Cape Newagen
Cape Rosier
Cape Split
Cape Elizabeth
Cape Neddick
Cape Porpoise
Cape Small
Cape Newagen
Cape Rosier
Cape Split



LEGEND

Natural-Gas Pipelines

Gas Field

General Gas Area

● Distribution Facilities operated by Pipeline Company or Affiliate

○ Distribution Facilities operated by Other Utilities

✸ ☼ Mixed Gas

E.C.JACOBSON

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Vol. 55, No. 10

THE OIL AND GAS

S JOURNAL'S MAP OF

ALBERTA
SASKATCHEWAN
MONTANA
IDAHO
WYOMING
DOMINION
Edson Station
Trans-Mtn.-24"
Jasper
Yellowhead Pass
Edson Sta.
Pacific Pipe Line Co.
Edson
Redwater
don Accord
Excelsior
Volmer
EDMONTON
Br. Am.-7,000
McColl-Frontenac-13,000
Edmonton R.L.-6"
Joseph Lk.
Golden Spike
Pembina-16"
Leduc
PEMBINA
KEYSTONE
Imperial-8"
Texas Mitchell-6"
Bonnie Glen
Pigeon Lk.
Camrose
Bardo
Kingsland
New Norway
Hardisty
Alhambra
Oliver
Shiloh
Sandow Lk.
Shiloh
Ribstone
Ribstone Creek
Oxbow
Oxbow Creek
Britannia
Oxbow
Oxbow Creek
Oxbow
Oxbow Creek
Britannia
Oxbow
Oxbow Creek
Britannia
Oxbow
Oxbow Creek
Britannia

AP OF Crude-Oil

SASKATCHEWAN

MANITOBA

ONTARIO

NORTH DAKOTA

SOUTH DAKOTA

MINNESOTA

NEBRASKA

Prince Albert
O Prince Albert Rpd
1,000

Kamsack
Northern Pet - 800

Yorkton
Sterling Ref. 750

Interprovincial P.L.Co.

Lansbarn Sta.

REGINA
Consumers Co-op 12,000
Imperial - 25,000
Regina Sta.

Future Boostar Sta.

Petroleum Ref.

Br. Am. 15,000

Broadview Sta.

REPELLA

DALY

HIDDEN-REPELLA

SPRINGBANK

Tilston

Boissevain Sta.

Brandon
Anglo Canadian Oils - 3,000
Anglo Canadian

WINNIPEG
Imperial 15,500
Radio Oil Ref - 1,500
North Star Oil - 15,000
McColl Frontenac - 2,500 (Proposed)

Mississippi Pipe Line Co., Ltd.
12 in. - 0

Morris
Trueno Oil Co.
1,500

Gretna Sta.

Ratcliffe

Plentywood

Creasby

Kenmare

Bottineau

Hallock

Baudette

International Falls

Crafton

Wking Sta.

Lakehead P.L.Co. Inc.

Minot

Rugby

Devils Lake

Williston

Hefflund

Charlson

Service P.L.

Grand Forks

Crookston

Clearbrook Sta.

Hibbing

Sidney

Beach

Belfield

Dickinson

Service

BISMARCK
Mandan
Std. Ind. 35,000

Jamestown
Std. Ind.

Moorhead
Fargo

Minnesota P.L.Co. - 16"

Monahga

Staples

Miles City

Baker

Bowman

Little Beaver

Linton

La Moure

Wahpeton

Alexandria

Little Falls

St Cloud
Std. Ind.

McIntosh

Buffalo

Bison

Eureka

Britton

Wheaton

Broadus

Aberdeen

Gettysburg

Redfield

Watertown

Madison

Minneapolis

Redwood Falls

Marshall

Mankato

Gillette

Deadwood

PIERRE

Huron

Rapid City

Kadoka

Madison

Mitchell

Sioux Falls

Rock Rapids

Spencer

Hot Springs

Martin

Oregory

Chadron

Valentine

Yankton

Vermilion

Hawarden

Sioux City

Sac City

Ft Dodge

Atkinson

Alliance

Brewster

Norfolk

Wisner

Onawa

Scottsbluff
Consolidated - 2,000

Torrington Sta.

Fiddler Cr.

Osage

Mush Cr.

Clareton

Lance Crk.

Ohio

Lusk

Manville

Glendo

Cantl.

Dalton

Service

Sidney

Texas

Cedar Crk.

Yellowstone

Shell-C
(Completed)

Pine Unit

Cabin

Talon

Terry

Quick Crk.

Plains P.L. Co. - 18"

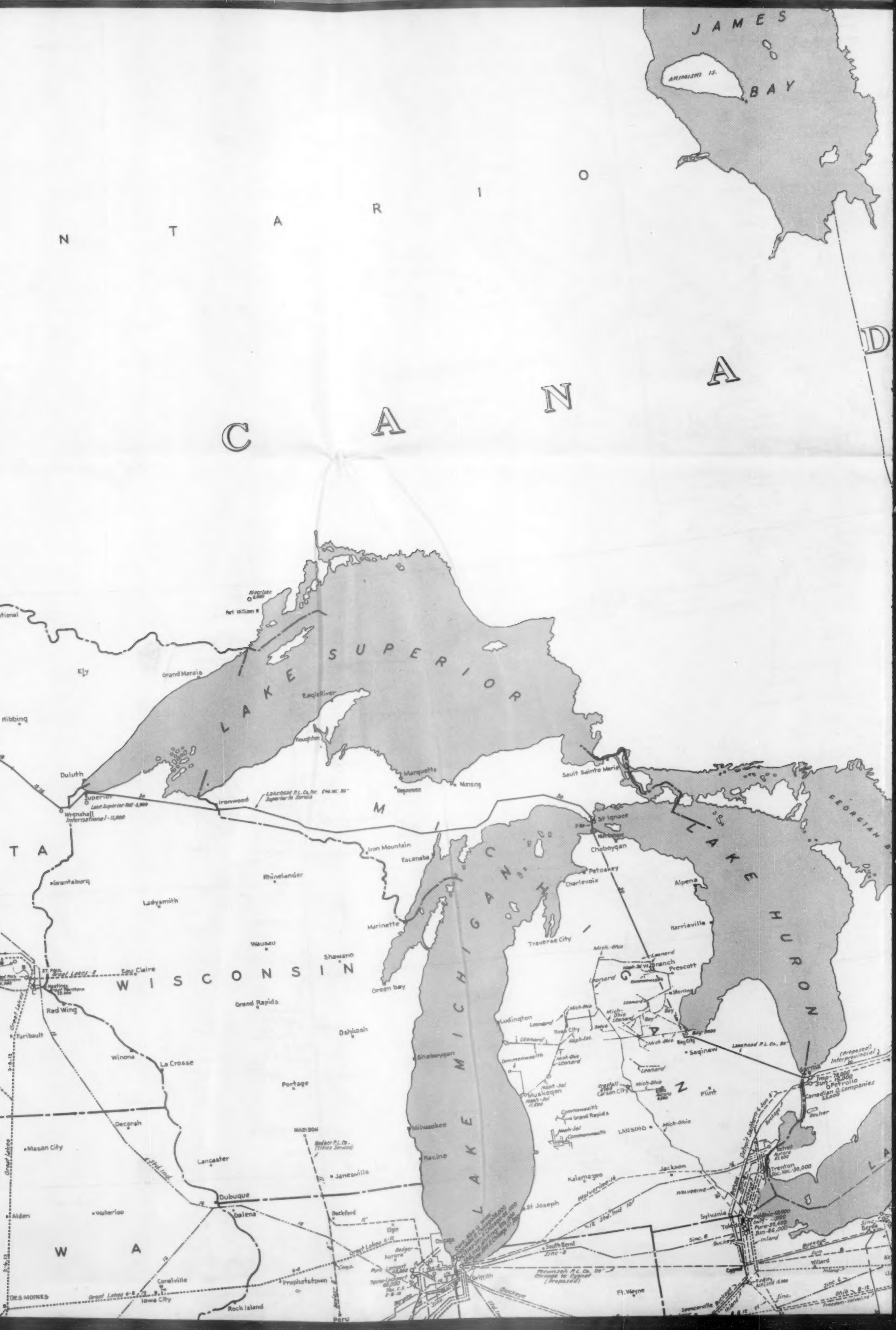
Grand Forks

Great Lakes

Service

Cantl.

and Product


JAMES
AKIMISKI IS.
BAY
ONTARIO
CANADA
LAKE SUPERIOR
Port William
Ely
Grand Marais
Eagle River
Hibbing
Houghton
Marquette
Negaunee
Munising
Sault Sainte Marie
Duluth
Superior
Ironwood
Wrenshall
St Ignace
Mackinaw
Cheboygan
Iron Mountain
Escanaba
Petoskey
Charlevoix
Alpena
Rhinelander
Grantsburg
Ladysmith
Marinette
Harrisville
Wausau
Shawano
Green bay
Traverse City
LAKE MICHIGAN
LAKE HURON
GEORGIAN B.
WISCONSIN
Eau Claire
Grand Rapids
Red Wing
Faribault
Winona
La Crosse
Portage
Oshkosh
Sheboygan
Milwaukee
Racine
Janesville
Beloit
Madison
Muskegon
Ludington
Saginaw
Flint
Lansing
Kalamazoo
St Joseph
Jackson
Detroit
Trenton
Sarnia
Mason City
Decorah
Lancaster
Dubuque
Galena
Waterloo
Alden
Iowa City
Rock Island
Peru
Prophetstown
Canalville
Des Moines
Backford
Elgin
Chicago
Griffith
South Bend
Ft. Wayne
Toledo
Sylvania
Willard
Monroe
Wolverine
Buckeye
Lakehead P.L. Co., 30"
Lakehead P.L. Co. Superior to Sarnia
Lakehead P.L. Co. 646 mi. 30"
Lakehead P.L. Co. Chicago to Sarnia (Proposed)
Tecumseh P.L. Co. Chicago to Sarnia (Proposed)
Badger P.L. Co. (Cities Service)
Commonwealth
Mich-Ohio
Leonard
Mapl-Sol
Bay
Bay City
Carson City
Grand Rapids
Jackson
Detroit Aurora 41,000
Trenton Soc. Inc.-30,000
Canadian Companies 25,000
Petrolia
Imp.-78,000
Sun-15,000
Pure-35,400
Sun-86,000
Inland
Sinc.-8
Sinc.-6
Sinc.-5
Lambton 15,000
Willard
Inland
Sinc.
Freedom-Valvoline
Lakehead P.L. Co., 30
(Proposed) Interprovincial
Lake Superior Ref.-6,000
Wrenshall International-11,000
Great Lakes 6-8
Great Lakes 8-12
Ohio 8-12
Sinc. 8
Sinc. 6
Sinc. 5
Buckeye
Inland
Aurora
Badger
Lemont 68,000
Tuscola-Lemont 68,000
Tec. C-3
6-8-10
Sinc.
Buckeye
Inland
Sinc.
Sinc.
Sinc.

Product Pi

JAMES
BAY
AKIMISKI IS.
R I O
Q U E
A D A
A N A
S U P E R I O R
Marquette
Sault Sainte Marie
Munising
Escanaba
Iron Mountain
Marinette
Green bay
Oshkosh
Sheboygan
Milwaukee
Racine
Janesville
Rockford
Elgin
Chicago
St Joseph
South Bend
Griffith
Peru
Ft. Wayne
Kalamazoo
Jackson
Lansing
Flint
Saginaw
Bay City
Muskegon
Grand Rapids
Ludington
Traverse City
Charlevoix
Petoskey
Cheboygan
St Ignace
Alpena
Harrisville
Prescott
Sterling
Escanaba
Manistique
Negaunee
Menominee
Shawano
L A K E M I C H I G A N
L A K E H U R O N
G E O R G I A N B A Y
L A K E E R I E
L A K E - O - N - T - A - R - I - O
Toledo
Detroit
Trenton
Sylvania
Willard
Akron
Cleveland
Mantua
Warren
Youngstown
Pittsburgh
Greensburg
Bellville
Kingston
Toronto
Hamilton
Lockport
Rochester
Batavia
Buffalo
Jamestown
Bradford
Olean
Warren
Tidioute
Titusville
Meadville
Clearfield
Altoona
Sarnia
Petrolia
Canadian
Imp
Sun
Leamington
Windsor
Wayland
Geneva
Big Flats
P E N N S Y L
N E W Y O R K

pelines

B
E
C
ST LAWRENCE RIVER
CHALEUR BAY
NEW BRUNSWICK
Ft. Kent
QUEBEC
Houlton
Patton
MAINE
Eastport
Bangor
Farmington
Soc.Mobil
AUGUSTA
Lewiston
Raymond
Portland
Gorham
W.Burke
Lunenburg
Portland P.L.Corp.
Highwater
Ste. Cesaire
Montreal P.L.Co.Ltd.
Canadian Petrofina 65,000
McColl-Frontenac-58,000
Imperial O. Ltd. - 55,000
British Am. Ltd. - 45,000
Shell O. Co. Ltd. - 45,000
Montreal
OTTAWA
Cornwall
St.Albans
Malone
Plattsburg
Ogdensburg
Brockville
Kingston
Watertown
Lake Pleasant
Johnstown
Utica
Waterford
ALBANY
Weedsport
Syracuse
Cortland
Ithaca
Sun
Binghamton
Endicott
Elmira
Big Flats
Buffalo (Atl.)
Soc. Mobil
Geneva
Hudson River (Waterway)
Kingston
Newburg
Mansfield
Buckeye
Scranton
Exeter
Atlantic
Williamsport
Tidewater
Mauch Chunk
Belvidere
Tidewater
Paterson
Jersey City
New York
Elizabeth
Linden
Sinclair
Mobil
California
Paulsboro
Pennsylvania
Harbor Products (Texas)
New Brunswick
Trenton
Philadelphia
Marcus Hook
Atlantic City
Wilmington
Delaware City
Lancaster
York
Lebanon
Reading
Harrisburg
Tuscarora
Sinc.
Sun
Southern
Penn Dixie
Penn Texas
Sun Atl.
Sinc.
Soc. Mobil
Soc. Mobil
Sun
Sun
Sun

PRINCIPAL CRUDE-OIL PIPELINE SYSTEMS

Arkansas Pipeline Corp.	Shreveport
Ashland Oil & Refining Co.	Ashland, Ky.
Atlantic Pipe Line Co.	Dallas
Basin Pipe Line System	Houston
Bayou Pipe Line System	Houston
Bell Oil & Gas Co.	Tulsa
Buckeye Pipe Line Co.	New York
Champlin Oil & Refining Co.	Fort Worth
Cherokee Crude Oil Pipe Line	Ponca City, Okla.
Cities Service Pipe Line Co.	Bartlesville, Okla.
Continental Pipe Line Co.	Ponca City, Okla.
Deep Rock Oil Co.	Oklahoma City
Derby Refining Co.	Wichita, Kans.
Eureka Pipe Line Co.	Parkersburg, W. Va.
General Petroleum Corp.	Los Angeles
Gulf Refining Co.	Houston
Humble Pipe Line Co.	Houston
Interstate Oil Pipe Line Co.	Shreveport
Kaw Pipe Line Co.	Tulsa
Lakehead Pipe Line Co.	Superior, Wis.
Leonard Crude Oil Co.	Mount Pleasant, Mich.
Lion Oil Co.—Monsanto	El Dorado, Ark.
Magnolia Pipe Line Co.	Dallas
Mid-Continent Pipe Line Co.	Tulsa
Mid-Valley Pipeline Co.	Longview, Tex.
National Transit Co.	Oil City, Pa.
Ohio Oil Co.	Findlay, Ohio
Ozark Pipe Line System	Houston
Pasotex Pipe Line Co.	Houston
Phillips Pipe Line Co.	Bartlesville, Okla.
Platte Pipe Line Co.	Kansas City, Mo.
Portland Pipe Line Corp.	Portland, Me.
Pure Transportation Co.	Chicago
Rancho Pipe Line Co.	Houston
Richfield Oil Corp.	Los Angeles
Salt Lake Pipe Line Co.	Salt Lake City
Service Pipe Line Co.	Tulsa
Shell Pipe Line Corp.	Houston
Sinclair Pipe Line Co.	Independence, Kans.
Skelly Oil Co.	Tulsa
Socony Mobil Oil Co., Inc.	New York
Sohio Petroleum Co.	Cleveland
Sohio Pipe Line Co.	St. Louis
Sohio Southern Pipelines, Inc.	St. Louis
Southern Pipe Line Corp.	Corpus Christi
Standard Oil Co. of California	San Francisco
Sun Pipe Line Co.	Beaumont
Suntide Pipe Line Co.	Corpus Christi
Texaco-Cities Service Pipe Line Co.	Tulsa
Texas-New Mexico Pipe Line Co.	Houston
Texas Pipe Line Co.	Houston
Tidewater Oil Co.	San Francisco
Tide-Water Pipe Co., Ltd.	Bradford, Pa.
Toronto Pipe Line Co.	Dallas
Union Oil Co. of California	Los Angeles
Utah Oil Pipe Line Co.	Salt Lake City
Valvoline Pipe Lines	Freedom, Pa.
West Texas Gulf Pipe Line Co.	Houston

UTAH
COLORADO
ARIZONA
NEW MEXICO
TEXAS
Green River
Evanston
Uintah
Vernal
Roosevelt
Ashley Crk.
Flat Mesa
N. Duchesne
Duchesne
Mt. Pleasant Valley
Eureka
Ely
Fillmore
Milford
Caliente
Escalante
St George
Kanab
Grand Canyon
Kingman
Flagstaff
Prescott
Winslow
St Johns
Phoenix
Luke AFB
Williams AFB
Ajo
Tucson
Davis Monthan AFB
Benson
Douglas
Bonanza
Rangely
Craig
Walden
Wilson Crk.
Price
American Gilsonite Co.
Gilsonite
Grand Jct.
Green River
Moab
Blanding
Monticello
Durango
Ignacio
Pagosa Spgs.
Farmington
Aztec
Bloomfield
Bisti
Chaco Unit
Lindrith
Cuba Area
Petit Arbeh-Tocito
San Juan Basin
Gallup
Hingale
Prewitt
Navajo
Hospah
Bernalillo
Albuquerque
Los Lunas
Estancia
Socorro
Silver City
Deming
Las Cruces
Lordsburg
El Paso
Texas
Pasotex
Jal
Wink
Artesia
Roswell
Hobbs
Carlsbad
Clovis
Portales
Tucumcari
Santa Fe
Cheyenne
Ft Collins
Greeley
Loveland
Denver
Empire - 8,000
Conf. L. - 12,000
Bay Pet. - 16,600
Oriental - 3,500
Skelly - 1,650
Colo. Interstate
Canon City
Florence
Pueblo
Gunnison
Leadville
Hugo
Walsenburg
Trinidad
Raton
Alamosa
Laramie
Horse Cr.
Pioneer
Pine Bluff
Arapahoe
Clarks Lake
Greeley
Kersey
Kiowa
Limon
Scottsbluff
Marfa
Midland
Odessa
Big Spring
Sweetwater
Abilene
Colorado City
Sterling
Phillips
Proposed Pipe Line
4" Four Corners Area To Los Angeles
Northwest Pipeline Corp. (Proposed Crude & Products)
Texas-New Mexico Pipe Line Co. (Proposed)
Standard Pipe Line Co. (Salt Lake)
Southern Pacific Pipe Lines, Inc.
Std. Texas - 24,000
Texas 5,500
Phillips-12,500
Salt Lake Pipe Line Co.
Salt Lake P.L. Co.
Ft. Collins Prod. Co.
Ft. Collins
Ft. Morgan
Wyco - Cheyenne
Wyco - Denver
Wyco - Sterling
Wyco - Scottsbluff
Wyco - Kersey
Wyco - Greeley
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Wyco - Flat Mesa
Wyco - Mt. Pleasant Valley
Wyco - Chapita Wells
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Wyco - Ashley Crk.
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Wyco - Raton
Wyco - Alamosa

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DES MOINES
Iowa City
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Oklahoma - Mississippi River Products Line, Inc.-12"
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LITTLE ROCK
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DeWitt
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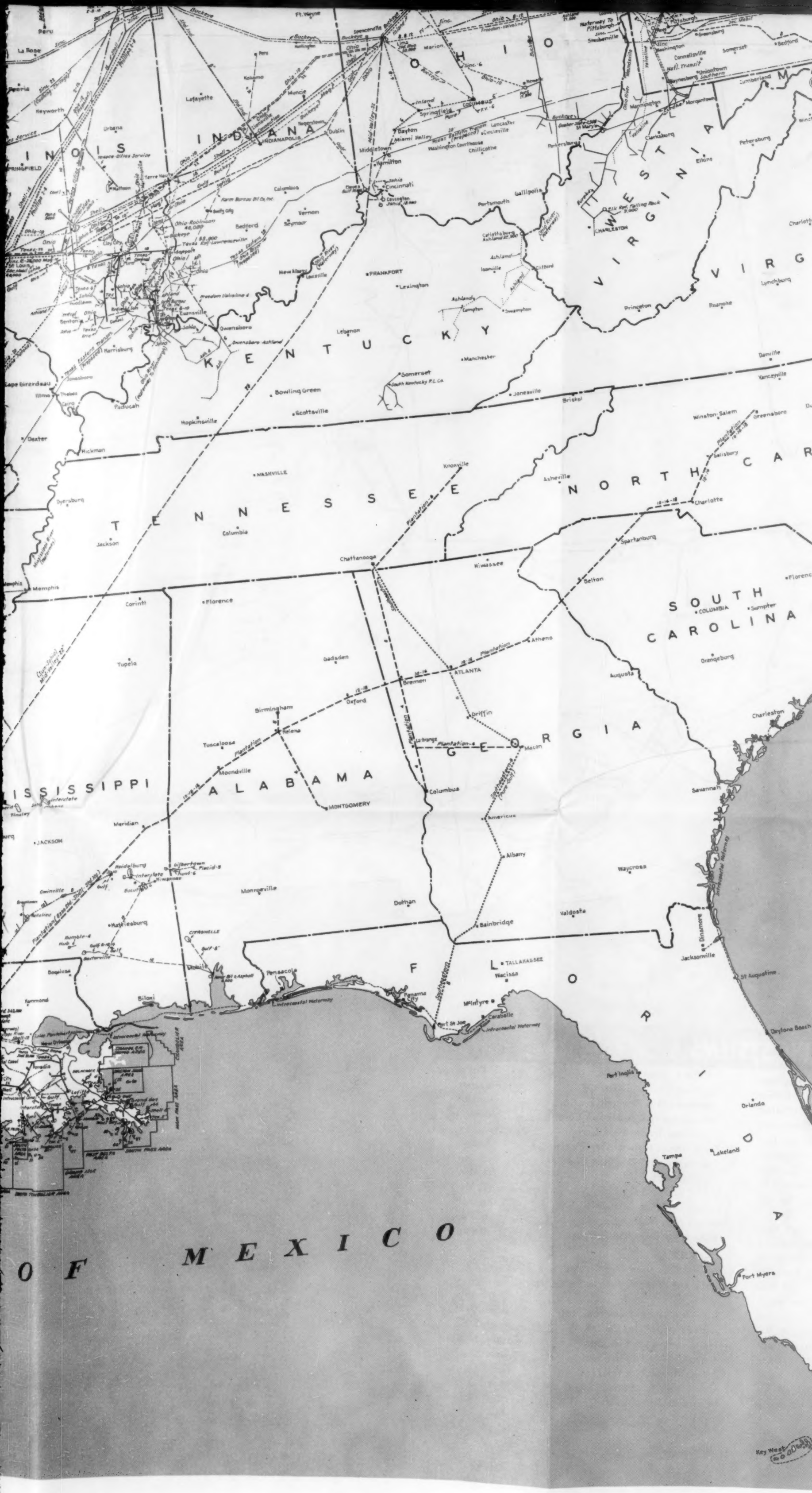
LOUISIANA
Natchitoches
Alexandria
De Ridder
Pine Prairie
Kinder
Deluosses (Shell) Bayou
Hammond
Biloxi
Pensacola
Panama City
Port St Joe
Intracoastal Waterway
Port Neches
Sabine Lake
Port Arthur
Texas City
Galveston
MAIN PASS AREA
WEST CAMERON AREA
EAST CAMERON AREA
VERMILION AREA
SOUTH PASS AREA
WEST DELTA AREA
GULF OF MEXICO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Uniontown
Morgantown
Cumberland
Waynesburg
Washington
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Wheeling
Marietta
Ashland
Huntington
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Gallipolis
Point Pleasant
Ohio River
Kanawha River
Monongahela River
Allegheny River
Big Sandy River
Tennessee River
Mississippi River
Cumberland River
Tombigbee River
Alabama River
Chattahoochee River
Flint River
Apalachicola River
Suwannee River
Withlacoochee River
Ocklawaha River
Intracoastal Waterway
Gulf of Mexico
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Indiana
Illinois
Kentucky
West Virginia
Virginia
Tennessee
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Florida
Buckeye
Shell
Gulf
Texaco
Sinclair
Standard
Phillips 66
Ohio-Robinson 48,000
Texas Eastern (proposed)
Plantation
Inland
Freedom-Valvoline
Ohio-10
Ohio-12
Ohio-16
Ohio-18
Ohio-20
Mid-Valley 20
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Texas Eastern Transm. (proposed)
Plantation (Esso Std. 30-211, 30-215)
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Plantation-10
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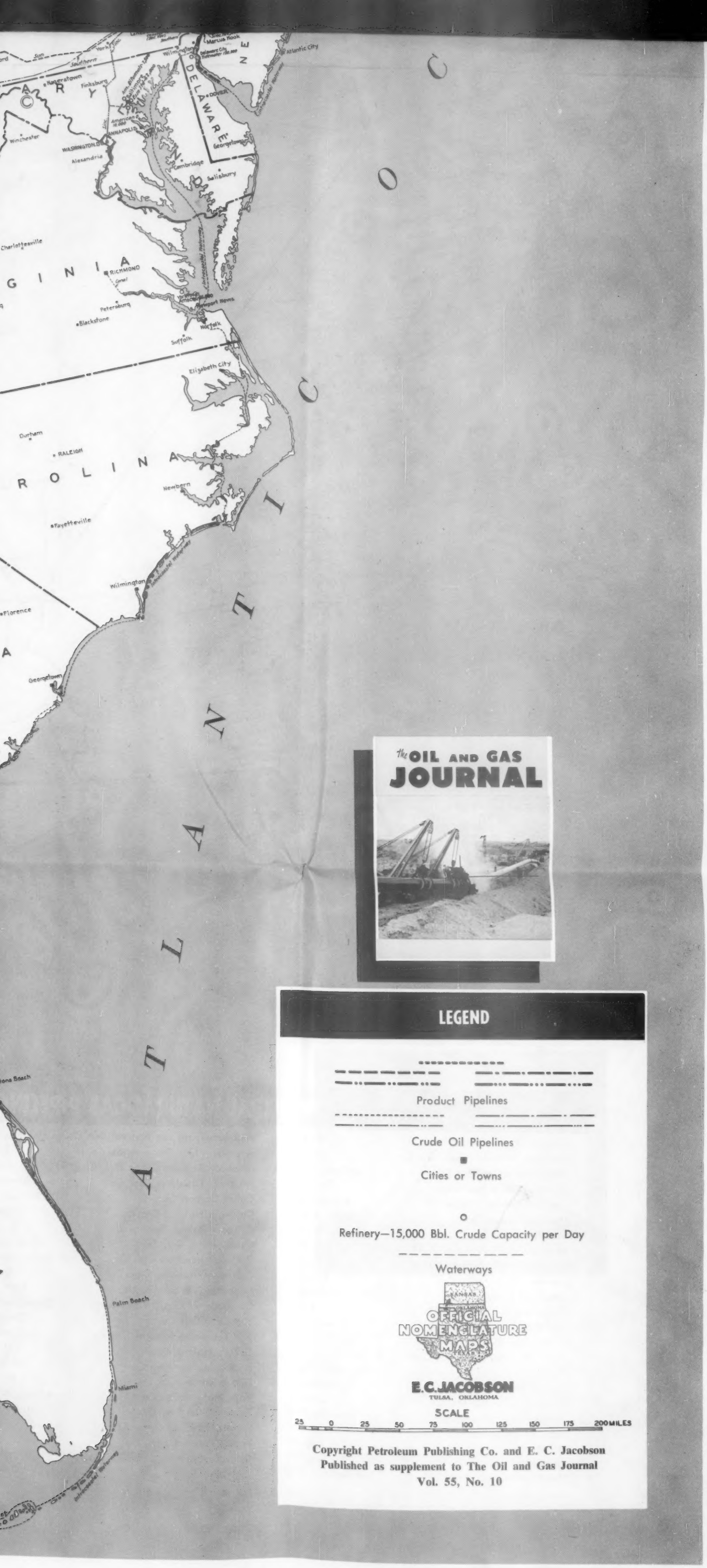

LEGEND

Product Pipelines

Crude Oil Pipelines

Cities or Towns

Refinery—15,000 Bbl. Crude Capacity per Day

Waterways

E.C.JACOBSON
TULSA, OKLAHOMA

SCALE

25 0 25 50 75 100 125 150 175 200 MILES

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THE STAFF

TULSA OFFICE
211 South Cheyenne Ave.
Phone Diamond 3-6291

Kenneth B. Barnes ..... Editor
Henry D. Ralph ..... Chief Editorial Writer
Ted A. Armstrong ..... News Editor
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Dr. Frank J. Gardner ..... Exploration Editor
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LaWanda Turner ..... Readership Research
Helen Brown ..... Editorial Assistant
Alice Burt ..... Editorial Assistant
Aileen Cantrell ..... Editorial Assistant
C. Dudley Johnston ..... Art Director
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NEW YORK OFFICE
500 Fifth Avenue
Phone LOngacre 4-6160

George H. Weber ..... Refining Editor
Paul Swain ..... International Editor
Ray G. Gibson ..... District Editor
John P. O'Donnell ..... District Editor

HOUSTON OFFICE
802 Sterling Building
Phone CApitol 4-7726

Larry Resen ..... District Editor
Ed McGhee ..... District Editor
Joe Reilly ..... Disfrict Editor

DALLAS OFFICE
1238 Mercantile Building
Phone Riverside 8-3074

Robert J. Enright ..... District Editor

LOS ANGELES OFFICE
650 South Grand Avenue
Phone VAndike 0722

D. H. Stormont ..... District Editor
William T. Smith ..... District Editor

WASHINGTON OFFICE
621 Albee Building
Phone District 7-1710

Bertram F. Linz ..... District Editor

Correspondents at Denver, Pittsburgh, Calgary, Columbus, Ashland, Ky., Oil City, Pa., Mount Pleasant, Mich., Melbourne, Australia; Regina, Sask.; Chatham, Ont.; Casper, Wyo., and Anchorage, Alaska.

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OIL AND GAS PIPELINES • REFINING • PETROCHEMICALS
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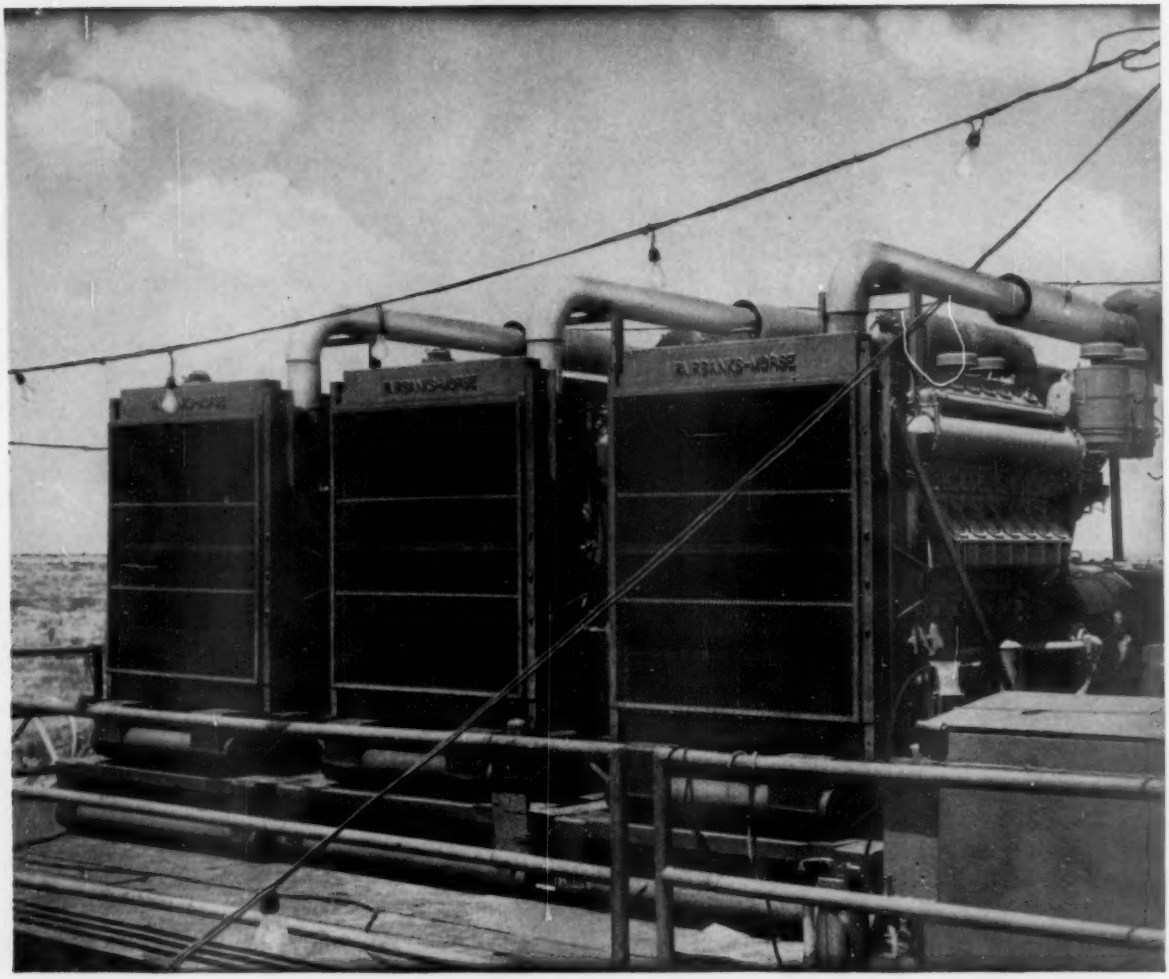


The 38-F-90 is a drilling engine

Here's Why

Fuel?... The 38-F-90 burns gas, propane or liquid fuel with the inherent economies of diesel compression.

Hp. rating?... Continuous slush pump rating is 75 hp. per cylinder, and the six sizes (4-5-6-7-8-10) include the right engine for any job between 300 and 750 hp. Whether four cylinders or ten, it's the same engine, the same width and height, the same operating technique. Many parts are interchangeable.

Speed range?... The 38-F-90 is rated for continuous heavy-duty service from 450 to 1200 RPM. This range is right for any mechanical, hydraulic or electric drive.

Give and take?... The 38-F-90 is a Fairbanks-Morse engine. This means that it will give service and take punishment. Its simplicity and its stamina are the result of its Opposed-Piston two-cycle design and its all-steel welded frame.

This all adds up to why the Fairbanks-Morse 38-F-90 is a *drilling* engine. Fairbanks, Morse & Co., Oil Field Division, Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

OIL FIELD EQUIPMENT • PUMPS • SCALES • ELECTRIC MOTORS • GENERATORS • LIGHT PLANTS • DIESEL, DUAL FUEL, GAS AND GASOLINE ENGINES MAGNETOS • DIESEL LOCOMOTIVES

B.F.Goodrich

Extreme bottom hole pressures won't burst B.F.Goodrich hose

THAT B.F.Goodrich Highflex rotary drill hose is built to handle the extreme bottom pressures that cause some hose to blow out.

Spiral-wrapped cable wires make the B.F.Goodrich Highflex hose burst-resistant, qualify it for Grade C (5000 lb. test pressure) American Petroleum Institute. Hose ends are reinforced with additional plies of wire and fabric to protect against bending stress at the couplings. Extra strength here means greater safety for your crew and rig—no hose blowouts at the coupling.

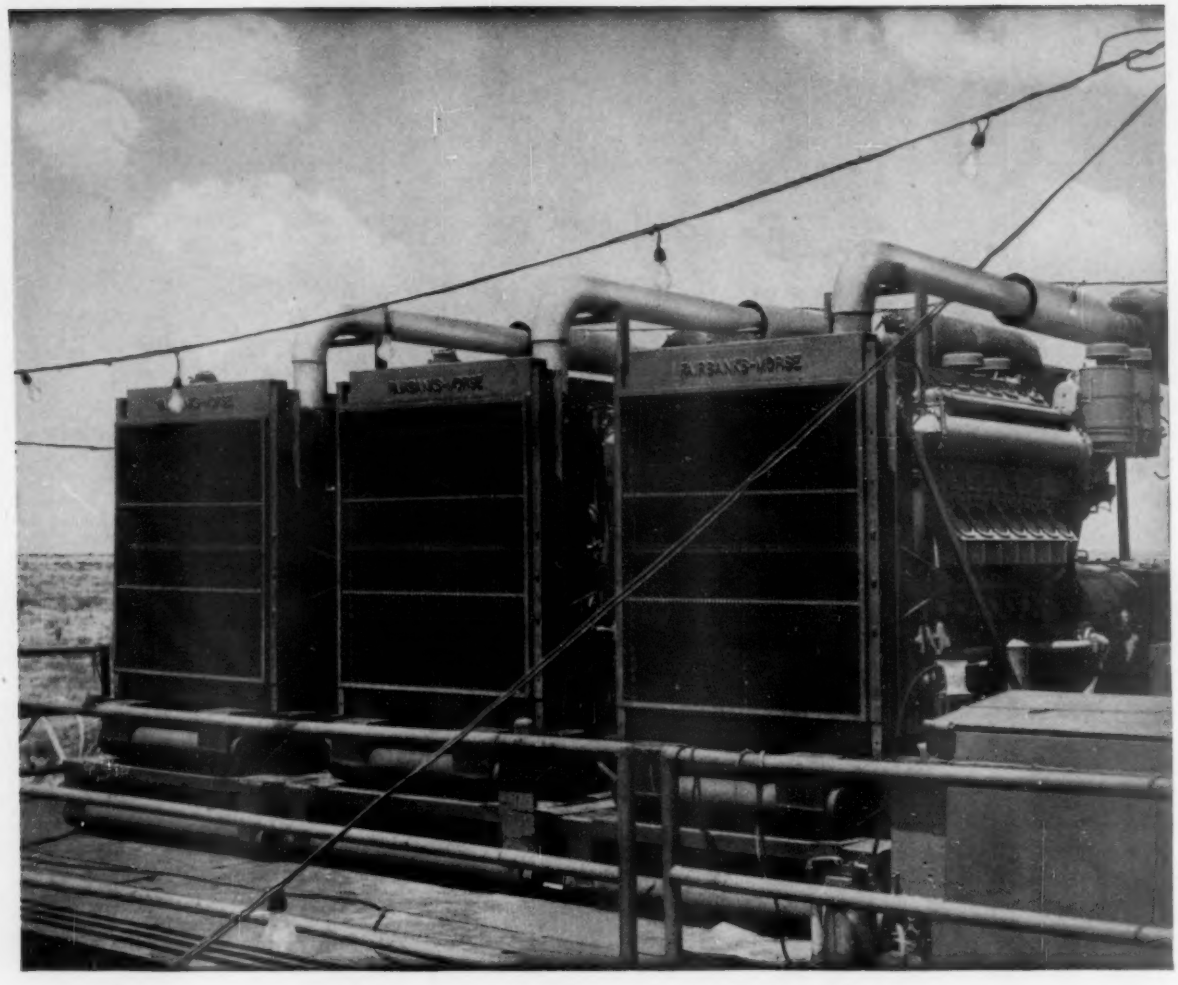
Highflex hose also has a thick, tough cover that stands more punishment, lasts longer on the rig. It resists gouges, scrapes, tears. Sun, wind and rain will not weaken it. Oily mud will not cause swelling or rotting of the tube.

For all its toughness, B.F.Goodrich Highflex is still the most flexible hose made for heavy duty service. It's easy to attach to the rig, hangs well from the standpipe, coils easily without kinking.

You'll find B.F.Goodrich Highflex hose at leading supply stores in the oil field, or at any of these B.F.Goodrich warehouses: Los Angeles, Great Bend, New Orleans, Hobbs, Oklahoma City, Tulsa, Dallas, Houston, Odessa, Wichita Falls. *B.F.Goodrich Industrial Products Co., Dept. M-896, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS



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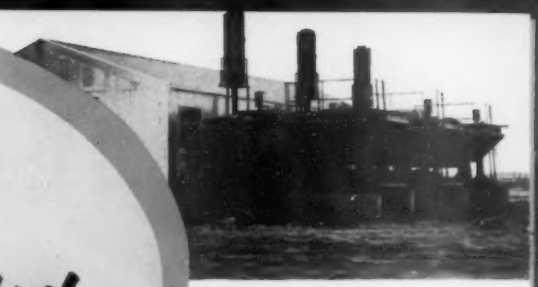
B.F.Goodrich

INDUSTRIAL PRODUCTS

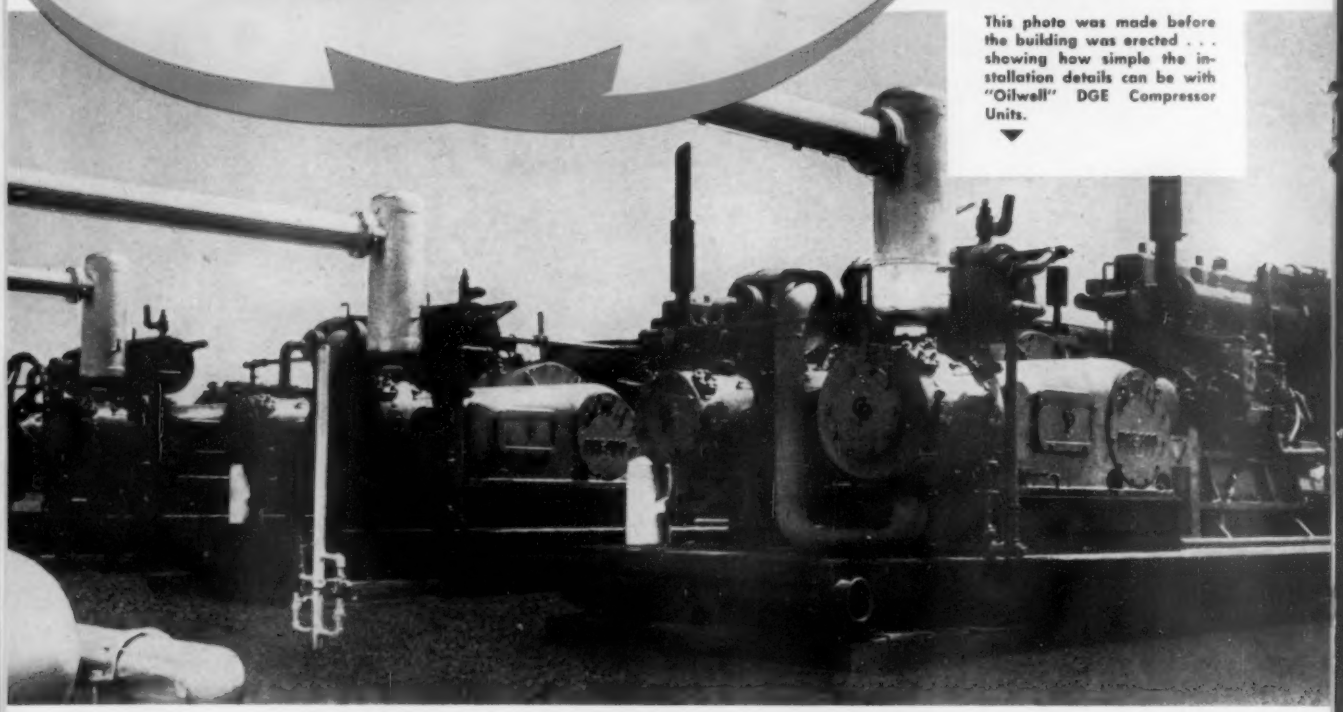
Another Gas-Gathering System relies upon

"Oilwell" Direct-Connected Compressor Units



In this application, cooling fans are positioned outside the building. Updraft action eliminated consideration of prevailing wind problems.

This photo was made before the building was erected . . . showing how simple the installation details can be with "Oilwell" DGE Compressor Units.



Near Graham, Texas, Universoil, Inc. is gathering gas at field pressures of approximately 20 psi and discharging it into transmission lines at 800 psi with "Oilwell" DGE-300 two-stage compressor units. In this installation, each of the three units has a capacity of approximately 1,275,000 cu. ft. per day at compressor speeds of 300 rpm.

These duplex units consist of two slow-speed, horizontal-type compressors with top suction and bottom discharge connections. They are mounted side by side and are driven through right-angle, spiral-bevel gears by a single prime mover—all on a common skid base.

Each unit has its own heavy-duty, horizontal, updraft radiator with divided core for separately cooling the engine and compressor. For 250 and 300 hp sizes, the radiator and fan assembly is mounted adjacent to the engine and driven from the crankshaft by means of a torque tube and fluid coupling.

An "Oilwell" Engineer will be glad to help you select the compressor that is best suited for your next application. Our various units, ranging in size from 20 up to 300 hp, provide a wide choice.

OIL WELL SUPPLY
DIVISION UNITED STATES STEEL CORPORATION

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NEW YORK 20, N. Y.

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DALLAS, TEXAS.....HOUSTON, TEXAS
TULSA, OKLA.....LOS ANGELES, CALIF.

Branches Serving All Oil Fields

USS TRADE MARK

"OILWELL"

TRADE MARK

UNITED STATES STEEL

Self-aligning

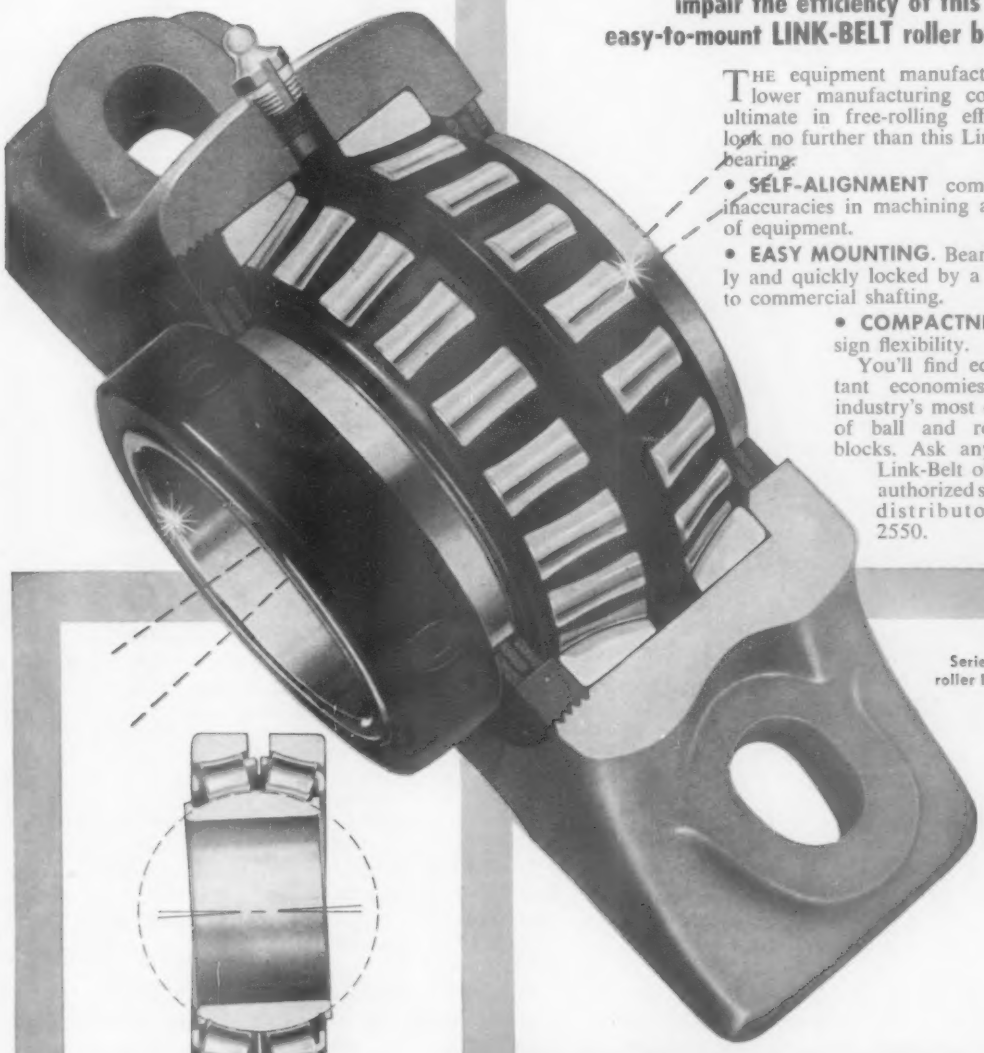
FOR LONGER LIFE

Not even misaligned shafts or supports impair the efficiency of this easy-to-mount LINK-BELT roller bearing

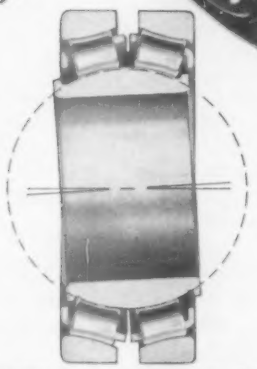
THE equipment manufacturer seeking lower manufacturing costs plus the ultimate in free-rolling efficiency need look no further than this Link-Belt roller bearing.

- **SELF-ALIGNMENT** compensates for inaccuracies in machining and assembly of equipment.
- **EASY MOUNTING.** Bearing is securely and quickly locked by a heavy collar to commercial shafting.
- **COMPACTNESS** offers design flexibility.

You'll find equally important economies throughout industry's most complete line of ball and roller bearing blocks. Ask any one of 40 Link-Belt offices or your authorized stock-carrying distributor for Book 2550. 14,440-B



Series 400 roller bearings



FREE ROLLING—SELF ALIGNING. Spherical inner ring aligns freely in any direction. Load is distributed over entire roller, assuring full capacity. Destructive edge loading cannot occur.

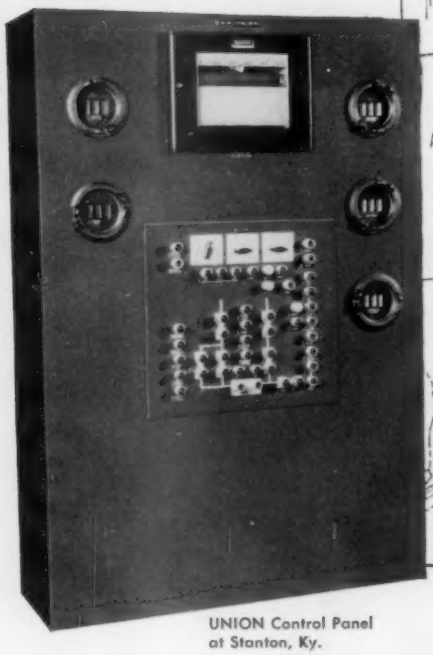
LINK LB BELT

self-aligning ball and roller bearings

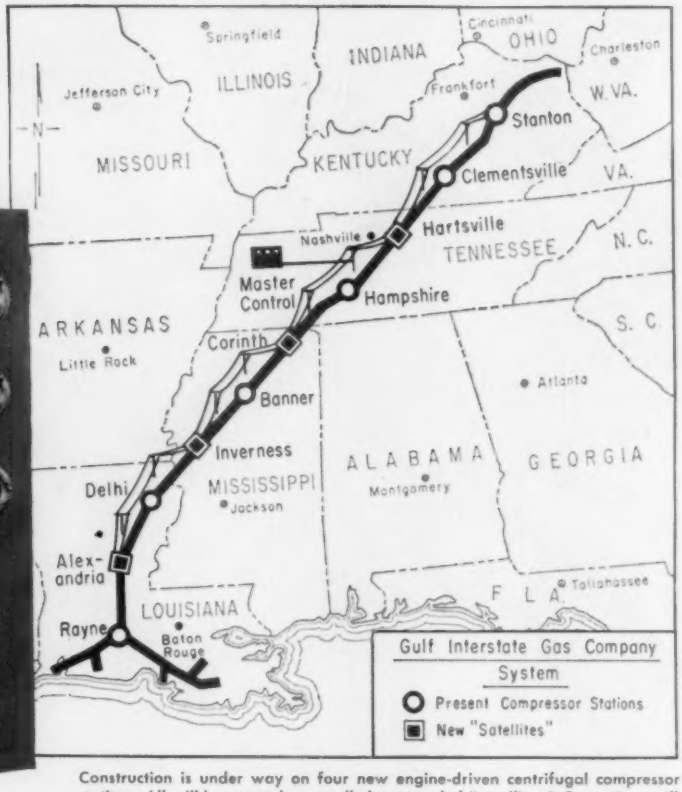
LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 21, Odessa, Tex., Shreveport, La., Los Angeles 33, Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields.

PIPELINE AUTOMATION PAYS!

Gulf Interstate's unattended "satellite" station shows how UNION C.T.C. lowers costs with safety and reliability.



UNION Control Panel at Stanton, Ky.



Construction is under way on four new engine-driven centrifugal compressor stations. All will be remotely controlled unattended "satellites." Operations will be directed from a UNION master control panel near the center of the system.

The Gulf Interstate Gas Company's "satellite" station at Stanton, Kentucky provides most economical and safe operation, according to Mr. R. Lo Chiano, assistant chief engineer at Gulf Interstate.

The Stanton station is remotely controlled from Clementsville, Ky., 90 miles away, through a UNION Centralized Transport Control System and has been on completely *unattended* operation since June 1956. This system is unique because it provides remote control and indications for a turbocharged engine driving a centrifugal gas compressor . . . the first installation of its kind. Large savings result because the operator at the master station can change the set point on the discharge pressure controller and start and stop the engine at Stanton.

Another important saving is obtained because the UNION C.T.C. System uses only one leased line circuit to transmit all the controls, indications and telemetering data. The control system used permits the use of the lowest-cost circuit. This installation was "custom engineered" using standard UNION components to meet the particular requirements.

The unattended station is definitely successful. There have been no false shut-downs that were not man made. With this in mind, future stations are being patterned after the one at Stanton.

Write for further information on UNION C.T.C. for all types of pipelines, gathering systems or tank farms. Ask for Bulletin 1052.

GENERAL APPARATUS SALES

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

NOW...
See the new OLIVER OC-4

See how many jobs you can do with this pony-size powerhouse!

For scores of different jobs around the oil fields, pipelines and refineries, this little, low-cost tractor is the practical, sensible answer. It gives you proved performance with 21.8 drawbar h.p. and a host of new operating features that mean you can work easier and faster. Here are a few:

NEW 4-speed transmission with a wider selection of speeds—from 1½ to 5¼ m.p.h.

NEW, big 9″ clutch for smooth operation, longer life.

NEW longer track for greater stability, and increased traction.

NEW ease and convenience for the operator, comfortable box type seat. Operator does more with less fatigue.

NEW low silhouette assures maximum visibility.

Best of all, the OC-4 costs far less than most specialized machines of limited ability. Look around your present jobs and see how many it can handle for you. It makes your equipment dollars do double duty.

Oliver now offers several different models with 21.8 drawbar h.p. to fit your needs with a full line of attachments, including loader, Jet-Trencher, dozer, angle-blade, Universal trencher, winch, etc.

Ask also about the "Little Boomer" for light pipe laying jobs. Its 2000-lb. lifting capacity is enough to carry 40′ length of pipe up to 12″ diameter. It frees your larger equipment for heavier work. Available with backfill blade and pipe bending shoes.

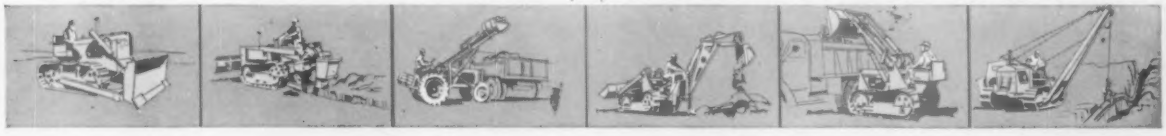
See your Oliver distributor today. Or write us.

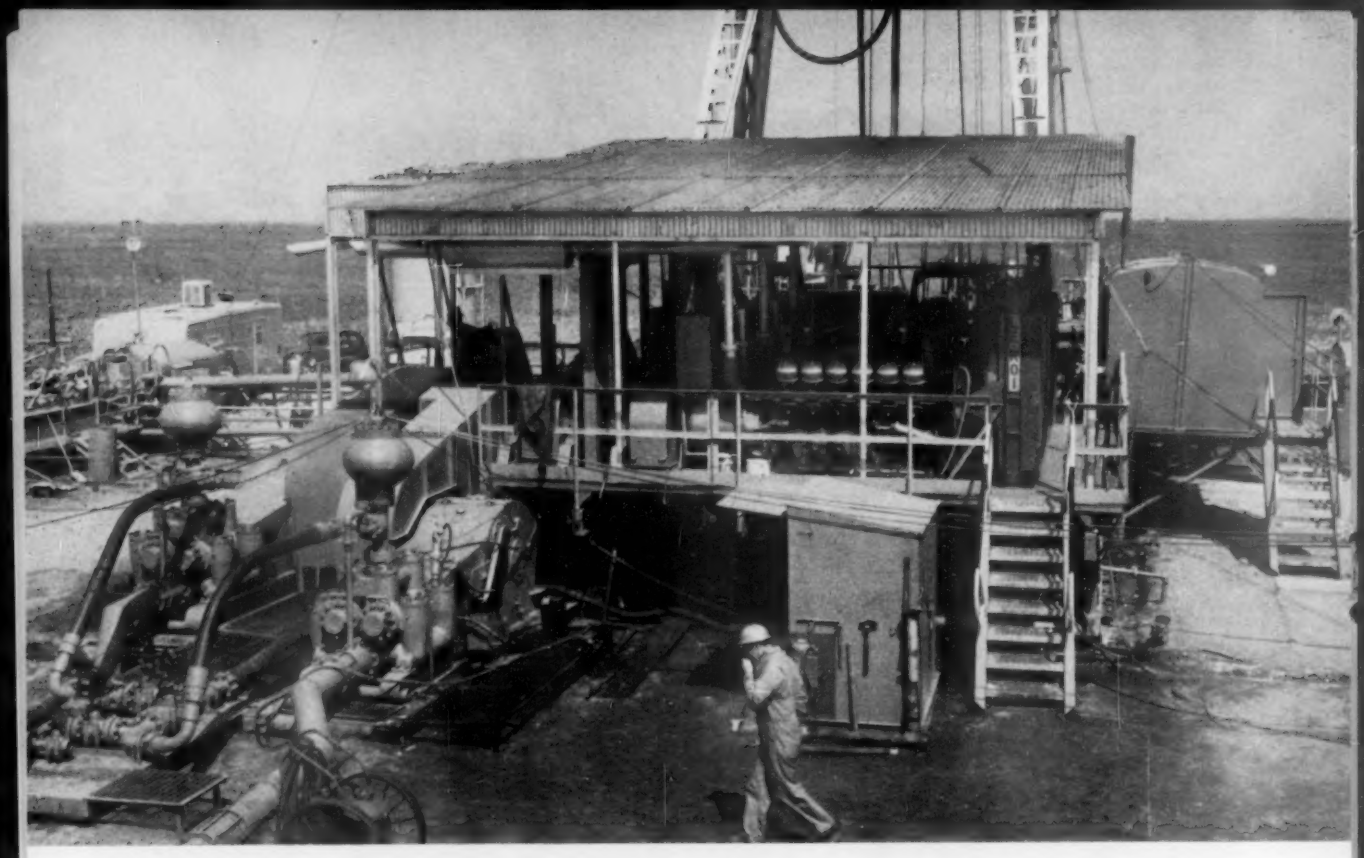
OLIVER

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

a complete line of industrial wheel and crawler tractors and matched allied equipment.





New High-Output Le Roi Engines Improve Torque-Converter Performance

Repowering rig results in smoother operation, better control, faster trips, and lower drilling costs.

This is a big rig — a rig with big hook-load capacity, a rig designed to handle treble stands. Its draw works and torque converters are built accordingly.

Original Le Roi L3000 engines broke field record. Originally equipped with three L3000 engines having a total maximum rating of 1248 hp, this rig established a new drilling record for the area in which it was working. But a rig of this size is meant for deeper holes; additional horsepower was needed to increase its capacity.

Rig repowered with Le Roi L3460's. The L3000 engines had given such a good account of themselves that three L3460's were chosen to provide the extra power needed. The rig now has a total maximum rating of 1800 horsepower — almost 600 horsepower more than the smaller L3000's put out.

Torque converters work better. When the L3460's were installed on this rig, their wide speed range and added horsepower improved torque-converter performance noticeably.

Rig flexible—easy to tear down or set up. Even with the additional power, the rig is easy to move. The L3460 is a compact V-12 engine that is only 164 inches long. It can be moved readily because it has integral crankcase and cylinder construction. This provides the rigidity needed to withstand the strains of oilfield handling.

Le Roi engines have the performance, the compactness and the durability to keep drilling costs to a minimum.

They are ideally suited for pipeline and generator applications. Sizes range from 208 to 625 horsepower. Write for our latest bulletins.

The L3460's are equipped with controlled shutters for maximum operating efficiency.

LE ROI Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin, manufacturers of Cleveland air tools, Tractair, portable and stationary air compressors, and heavy-duty industrial engines. Write us for information on any of these products.

P-149

RIGHT, in every case

CHAPMAN STEEL VALVES

Check them off, one by one. They're all important to you, a user of valves . . . steel valves. You want close tolerances; tight and positive seats; smooth, dependable, operation without jamming, chattering or excessive wear. Even with long service under the most severe conditions you want to cut your maintenance costs to a new rock bottom low.

Name your metal. You can have Chapman Steel Valves in standard alloys for normal requirements . . . or special alloys for extra service conditions. And for *your* benefit, all of these alloys are poured in Chapman's own foundries under rigid technical supervision.

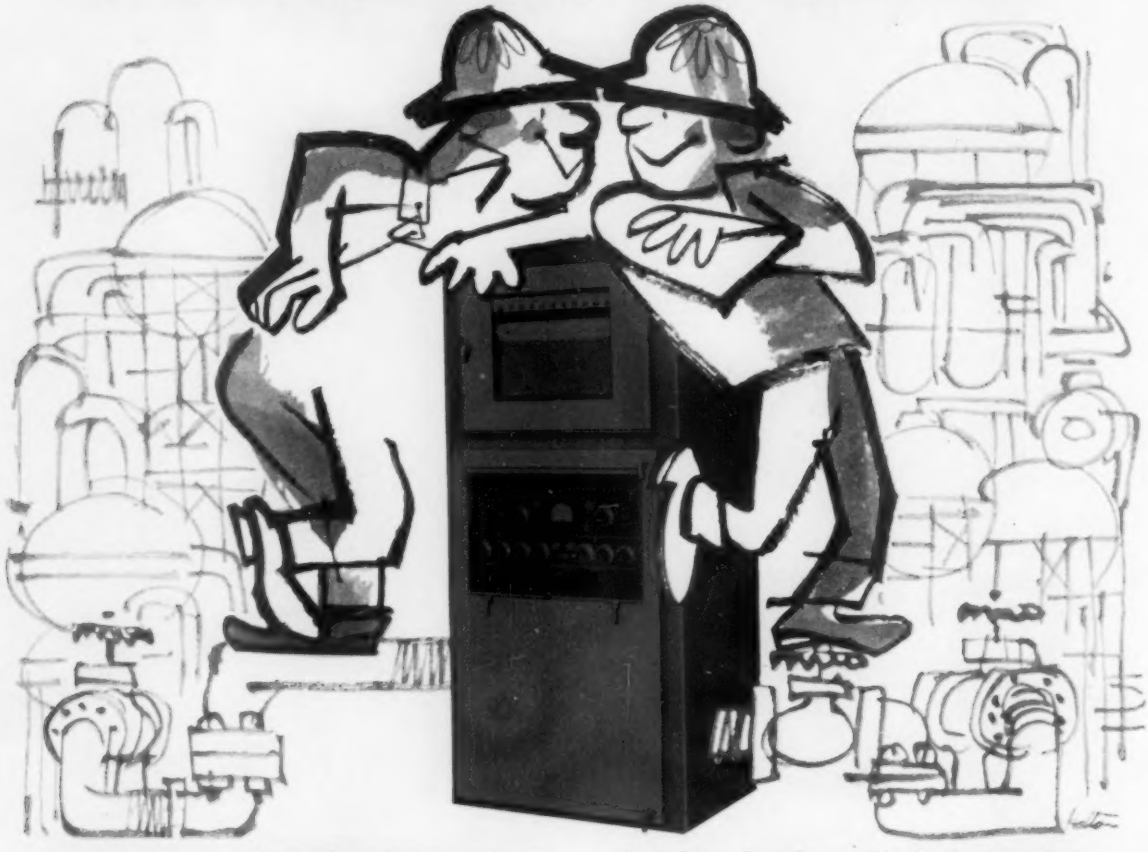
Chapman superior steel valves — gates, globes, checks — are available for all pressure and temperature ranges. You can order them with bolted, welded or pressure seal body and bonnet joints and with flanged or welding ends. They all equal or exceed ASA and API standards in every range.

Why not write now for our complete descriptive catalog No. 20.

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASS.

Continuous stream analysis . . . for optimum process yields.

Good walls make good neighbors...

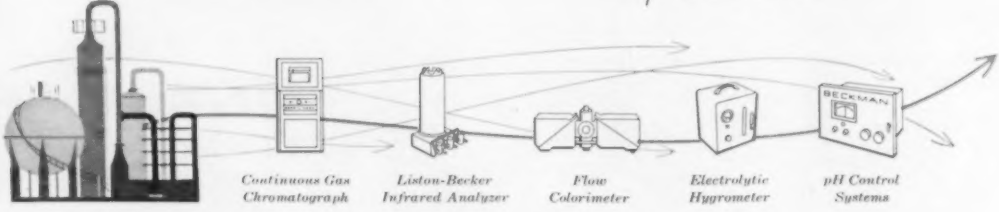


. . . So do good analytical instruments. **Most chemical plants are linked by raw material transfers. It's good business as well as neighborly to know the precise purity and concentration of what's being bought or sold. The Beckman Industrial Gas Chromatograph supplies this information—automatically, and in a graphic form that prevents any possible misunderstandings.**

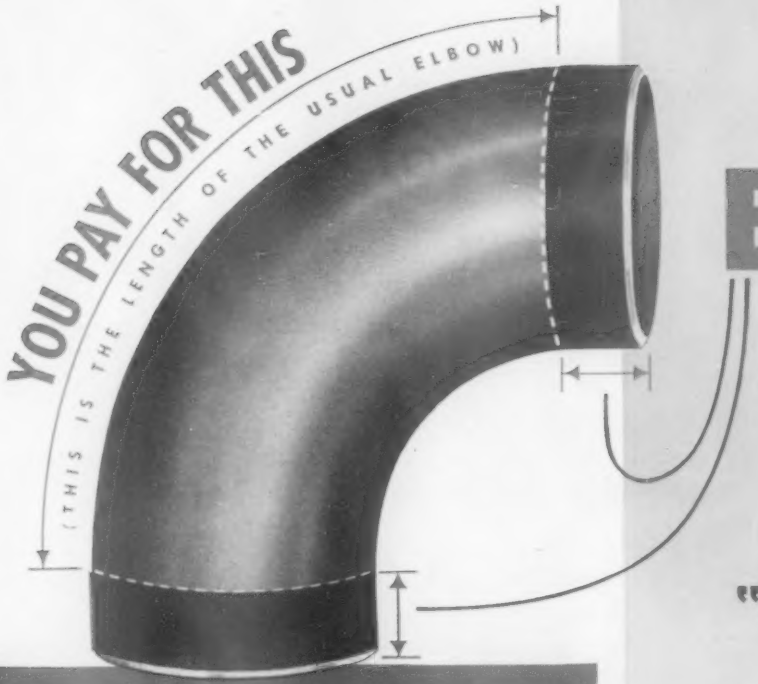
The Beckman Model 220 Industrial Gas Chromatograph provides control engineers with a simple, fast, reliable method of continuously monitoring the composition of gases or liquids. It is especially recommended for precise measurement of oxygen, nitrogen, chlorine, carbon monoxide, sulphur dioxide, and saturated, unsaturated, aromatic or halogenated hydrocarbons containing eight atoms of carbon or fewer. It can be adapted to sample automatically from three separate streams in sequence. The analyzer unit meets explosion-proof requirements. Detection limit is approximately 100 ppm, depending on the problem; reading on individual components down to 1% may be expanded to full scale. Reproducibility is ½-2% full scale; stability, 0.1% full scale. Analysis record is presented as a complete chromatogram or a bar chart of up to eight critical components. Analysis speed is 5 to 30 min., according to problem. Beckman's Application Engineering staff tailors the Model 220 to specific problems. Write for Data File P-3-24.

Beckman® / *Process Instruments*
Beckman Instruments, Inc.
Fullerton, California

Stream Analyzers for Industry



Continuous Gas Chromatograph | *Liston-Becker Infrared Analyzer* | *Flow Colorimeter* | *Electrolytic Hygrometer* | *pH Control Systems*



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A

BONUS

WITH EVERY

MIDWEST

"LONG TANGENT"

ELBOW

21% to 42% MORE ELBOW AT NO EXTRA COST

It's a built-in bonus that comes right with the elbow . . . a tangent or straight section at each end of the fitting.* Benefits of this bonus . . . this extra value . . . are yours AT NO EXTRA COST because Midwest "Long Tangent" Elbows are PRICED THE SAME AS OTHER ELBOWS. It's a value you can't afford to miss.

For additional information, ask your Midwest distributor or write us for Catalog 54.

*Size 24" and smaller have tangents equal to ¼ nominal pipe size; for example, 12" ell has 3" straight ends. Above 24" pipe size, all tangents are 6" long.

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- They save pipe.
- They often eliminate short nipples and their extra welds.
- They save time and money in lining up and clamping pipe and fitting.
- They make it easier to apply slip-on flanges.
- They remove the circumferential weld from point of maximum stress and can be sleeved.

THEY COST NO MORE THAN OTHER ELBOWS

MIDWEST PIPING COMPANY, INC.

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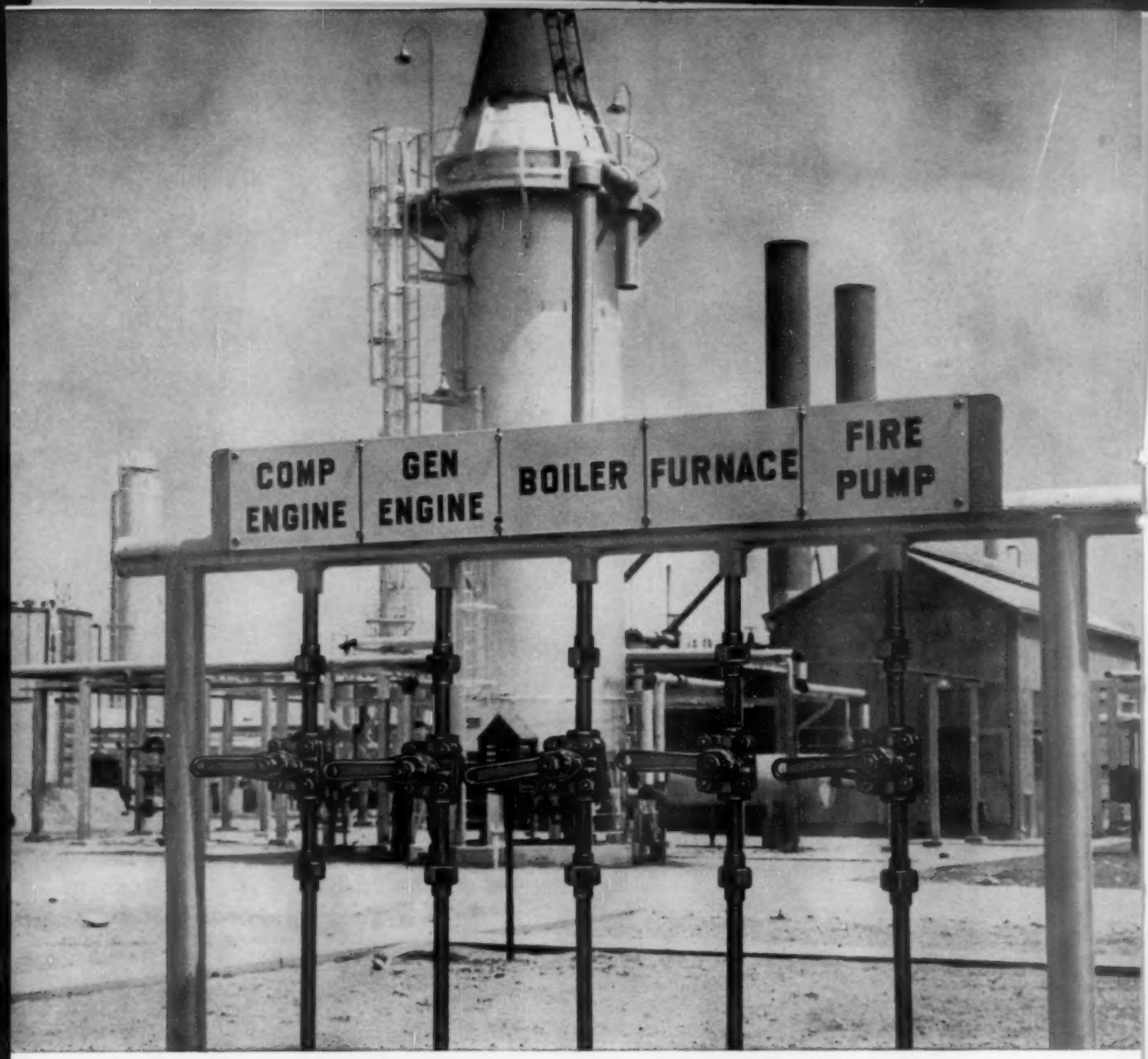
MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



THE LITTLE VALVES WITH THE BIG JOB

The Rockwell-Nordstrom valves on the emergency shut-off manifold above have a really big job. On their absolute dependability rests millions of dollars of capital investment.

Why do you so often see Rockwell-Nordstrom lubricated plug valves in the really vital spots? The answer: users know they provide *both* essentials of a truly dependable valve. They won't stick or gall—pressurized lubricant readies the plug for *instant, quarter-turn operation*. And, equally important, they assure *positive shut-off*.

These same important advantages—instant operation and positive shut-off—also make Rockwell-Nordstrom valves your best investment for practically every flow control need. And they cost no more to buy, often less, than ordinary valves. For complete details, call your supplier or write Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee:* Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

Lubricant Sealed For Positive Shut-off

A NEW NAME in Pumping Units

- Rigidly braced, four-legged Samson Post
- Saddle and equalizer bearings are bronze bushings
- Arc type hanger with vertical adjustment
- Herringbone gear reducer with positive bearing lubrication
- Roller bearings designed for over 100,000 hours B-10 life

See the new Aztec pumping unit at your favorite supply store soon. Compare it, try it, and prove it's your best pumping unit buy.

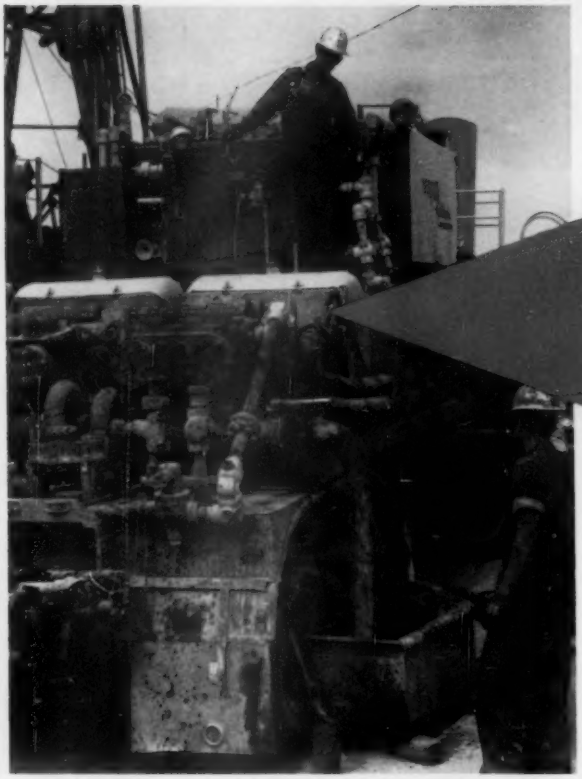
AZTEC - built to outperform the best!

Before designing the new Aztec pumping unit, we studied the requirements of many oil producers. As a result, Aztec units combine *many important field-proven features* with the latest design principles developed through our own extensive manufacturing experience.

Aztec units are available NOW in sizes up to 7,000 pounds API polished rod load capacity. They are built to API specifications in the industry's newest, most up-to-date manufacturing plant. Rapid expansion of the new line will soon make available a complete range of sizes. Your favorite supply store will gladly furnish you with information and prices on Aztec pumping units.

AZTEC MANUFACTURING CO.

2901 W. PAFFORD STREET
P. O. BOX 11427
FORT WORTH, TEXAS



MAKING THE MOST OF YOUR WELL

WITH HALLIBURTON'S SQUEEZE CEMENTING TECHNIQUES

In these days, when the world's thirst for oil is the greatest known in history, every available pay zone is of vital importance—either as potential reserve or for immediate production. With the trend toward deeper drilling in which several productive zones may occur in the same well, Halliburton squeeze cementing techniques plugging off unwanted fluids, minimizing danger of contamination of other zones, aid in providing for production from selected zones and sealing off those reserved for future production . . . allowing almost unlimited selectivity at any point in the well.

Squeeze cementing, the Halliburton way, not only furnishes immediate remedial requirements. It also makes it easier and less costly to re-enter the well when further operations may be desired to re-stimulate production. You save on the initial squeeze job . . . and on every job thereafter . . . and you prolong the "life expectancy" of your well.

When you specify Halliburton Squeeze Cementing, you get the benefit of the "know-how" of 3-million-job experience and the "know-why" of 34 years of research plus an intelligent integration of other services dedicated to profitable production for the life of your well. That's why it pays to start with Halliburton . . . and profit all the way.

Call the local or district office or write the Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

ASK FOR YOUR FREE COPY OF OUR NEW BULLETIN ON
DM-DC Squeeze Packers and Bridge Plugs and Electric Wire Line Powder Type Setting Tool

HALLIBURTON

BETTER TOOLS FOR BETTER SQUEEZE JOBS

BETTER MATERIALS FOR BETTER RESULTS

DOC—DIESEL OIL CEMENT

Where water shut-off is a problem Halliburton's DOC (Diesel Oil Cement) is the effective, economical answer. This unique cement has unlimited pumping time because it does not set until it contacts water. Therefore, in a well where the formation is producing water and oil, the DOC slurry can be pumped in place, the squeeze completed and the excess slurry reversed out with ease.

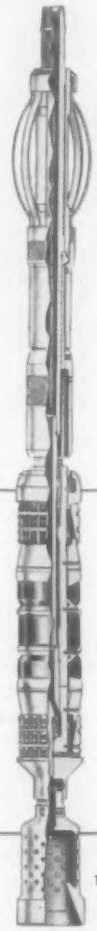
POZMIX CEMENT

Halliburton's Pozmix Cement with accelerators, retarders, fluid loss or weight control additives can be blended to give excellent results over a wide range of well conditions.

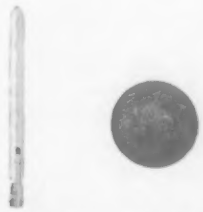
RESIN CEMENT

For conditions where it is necessary to obtain a tight durable seal in porous permeable formations, Halliburton's Resin Cement employs a resin which, when in the fluid phase, penetrates the formation to a predetermined distance and sets up in a firm hard mass when squeeze pressures are applied.

An excellent example of Halliburton's integration of tools and techniques is the Type "DM" or Type "DC" Squeeze Packer... specially designed for squeeze cementing. Simple and easy to set, these dependable packers may be run on drill pipe, tubing, a drilling line or with electric wire line powder type setting tool. They provide a positive fluid "shut-off" from either direction. Tubing and circulating valve are free from Packer before squeeze begins. These drillable squeeze packers become Bridge Plugs when a Sealing Plug or Ball is dropped or pumped in place after the Packer is set.



Type "DM"—"DC" Squeeze Packer on tubing string.

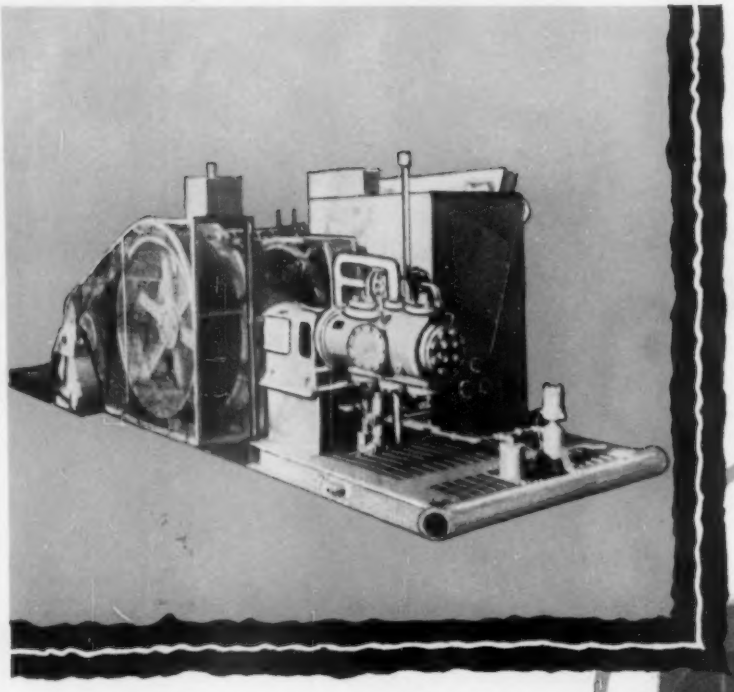


When used for a Bridge Plug, a Sealing Plug (left) or a Bridging Ball (right) is used to form an effective seal. Other types of plugs are also available.

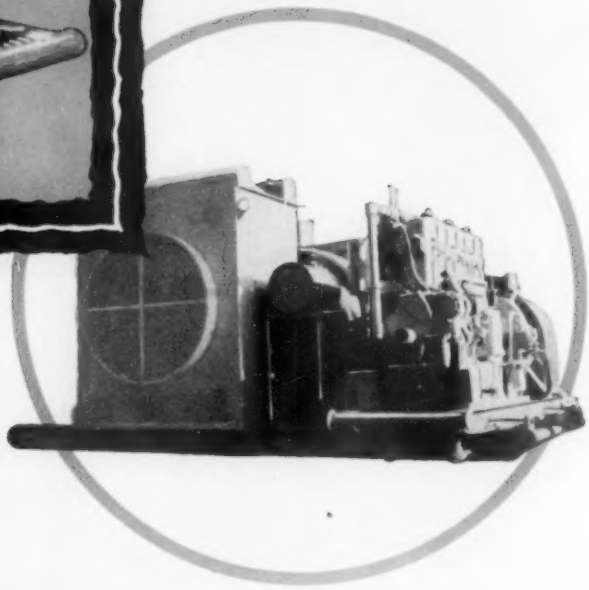
Type "DM"—"DC" Squeeze Packer on electric wire line with powder type setting tool.

CEMENTING SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG



NEW...



the Southern Packaged Gas Compressor Units

Two great products—LE ROI ENGINES and WORTHINGTON COMPRESSORS—are used by SOUTHERN ENGINE & PUMP COMPANY in their packaged gas compressor units.

These Southern packaged units are custom designed, engineered, and assembled in Southern Engine's Houston shops, utilizing 49 years experience with engines and compressors in the oil and gas industry. Every component in these sturdy skid-mounted units has been selected for dependable service. The design reflects careful planning from every angle. The service man is given more working area by placing the horizontal separator and most of the piping within the base. For safety and cleanliness, flush-mounted grating is used for decking. The engines range from 50 H.P. to 600 maximum H.P.; compressors have either 9″, 11″, or 13″ strokes with various cylinder sizes. Units may be furnished with a central cooler for engine cooling, gas inter and after cooling and compressor cooling.

Southern Engine & Pump Company engineers initially service the complete unit and aid in its installation. The customer is furnished a complete unit assembly drawing, structural base drawing, and anchor bolt detail.

For complete information on these SOUTHERN PACKAGED GAS COMPRESSOR UNITS, write for a folder or call Southern Engine's nearest branch office.

Distributors

SOUTHERN ENGINE & PUMP COMPANY

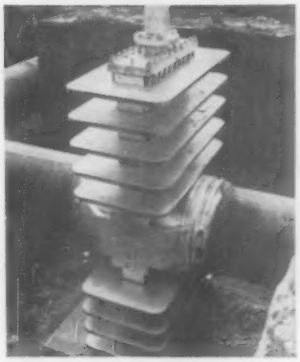
MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS

Houston • Dallas • San Antonio • Edinburg • Kilgore

Corpus Christi, Texas • New Orleans and Lafayette, Louisiana

Perfect through-conduit alignment simplifies hot tapping through this 22" ASA 600 valve.

34" full opening high pressure gas valve will stay bubble-tight underground—with no lubrication or maintenance.

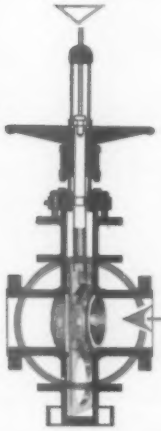


Ease of operation is of prime importance on frequently used manifold installations.

PERFORMANCE in the field points up the BIG DIFFERENCE

— in bubble-tight seal you can check in the line
— in easier operation with no wedging or jamming
— in lower maintenance with no need for lubrication
— in through-conduit always in line with the line

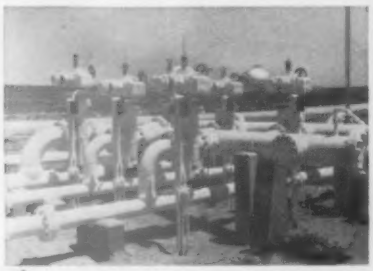
Thousands of pipeline, manifold and storage installations in gas and liquid services are daily adding to the record of performance that makes Grove *Seal-O-Ring* Gate Valves stand out as the practical answer to operating problems. If you have any doubt, ask men who are using them. It will pay you to specify Grove *Seal-O-Ring* Valves with the fabricated steel body—2" to 36"—in any standard pressure. Call your Grove representative or write today for details.



THE WHOLE VALVE IS RIGHT HERE

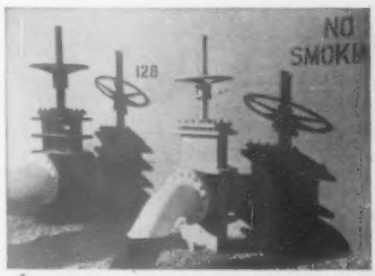
When valve is full open or closed, bubble-tight seals on both sides of the gate completely isolate line pressure in the conduit. The body, serving merely as framework for operating mechanism and to prevent loss of product while gate is in motion, may be drained or vented to atmosphere when gate is open or closed. Integrity of seals can be checked any time by a tell-tale valve on the body.

703



Products manifold at pipeline station illustrates typical motor-operated *Seal-O-Ring* Valve application.

LPG tank-to-pipeline is critical service where it's well to be able to check seal in the line—any time.



Self-cleaning feature is particularly important on crude oil tank lines.

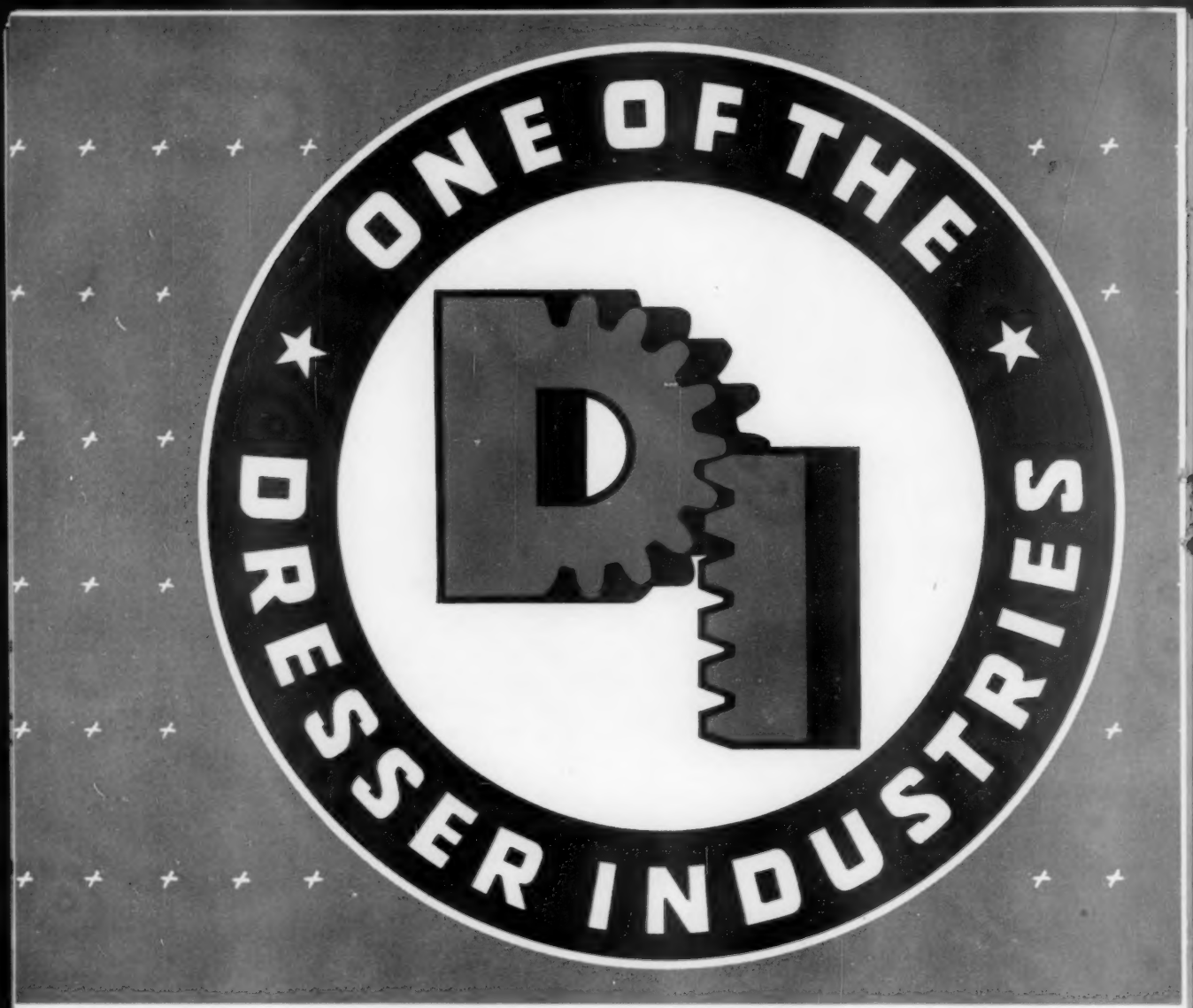
GROVE SEAL-"O"-RING Gate Valves

SUBSIDIARY OF WALWORTH

GROVE VALVE and REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, Calif.
HOUSTON 4—1901 Calumet St. • • • • • LOS ANGELES 6—1930 W. Olympic Blvd.

GROVE SEAL O RING ® GROVE SIMPLICITY ACCURACY SAFETY

ODESSA, TEXAS • TULSA, OKLAHOMA • DENVER, COLORADO • In Western Canada: GROVE VALVE LIMITED



CLARK

CLARK BROS. CO., Olean, New York—Gas turbines, engines, and reciprocating, centrifugal and axial flow compressors — gas, steam, electric and diesel driven.

DRESSER IDECO

DRESSER-IDECO COMPANY, Columbus, Ohio — Radio and television broadcasting towers, steel buildings, aircraft hangars, electric power substations.

DRESSER MANUFACTURING DIVISION

DRESSER MANUFACTURING DIVISION, Bradford, Pa. — Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

GUIBERSON

THE GUIBERSON CORPORATION, Dallas, Tex. — Swabs, packers, anchors, workover equipment — drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Gas lift equipment. Molded rubber products.

LANE WELLS

LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot* perforating, bullet perforating, packers, bridging plugs.

Magcobar.

MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar* and Magcogel* drilling muds and other specialized oil well drilling fluids and chemicals.

PACIFIC

PACIFIC PUMPS, INC., Huntington Park, Calif. — Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

ROOTS-CONNERSVILLE

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, vacuum pumps, and positive displacement meters.

* Trademark registered

SIE

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., Houston, Tex.—Seismograph systems and instruments—electronic, electro-mechanical. Computers—analog and digital; recording systems. Special transformers, reactors.

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...it identifies all Dresser Companies and their products... it is your guarantee of the DRESSER *plus*+

You gain an important extra plus value every time you are served by any of the Dresser companies. This is the unique way Dresser operates to serve you better. Each Dresser company works independently to assure maximum individual attention to your specific needs . . . yet all are teamed together in a single organization to provide a group of research, engineering, and manufacturing services. From Dresser you obtain equipment based on the over-all experience of many companies in many industries.

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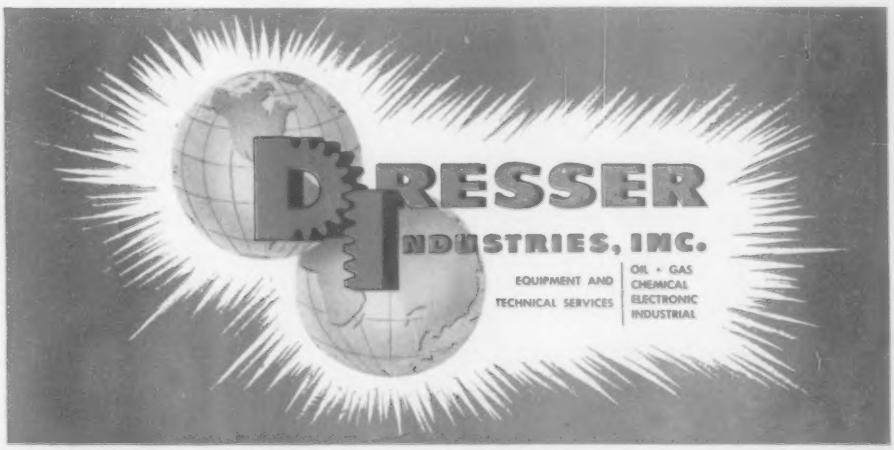
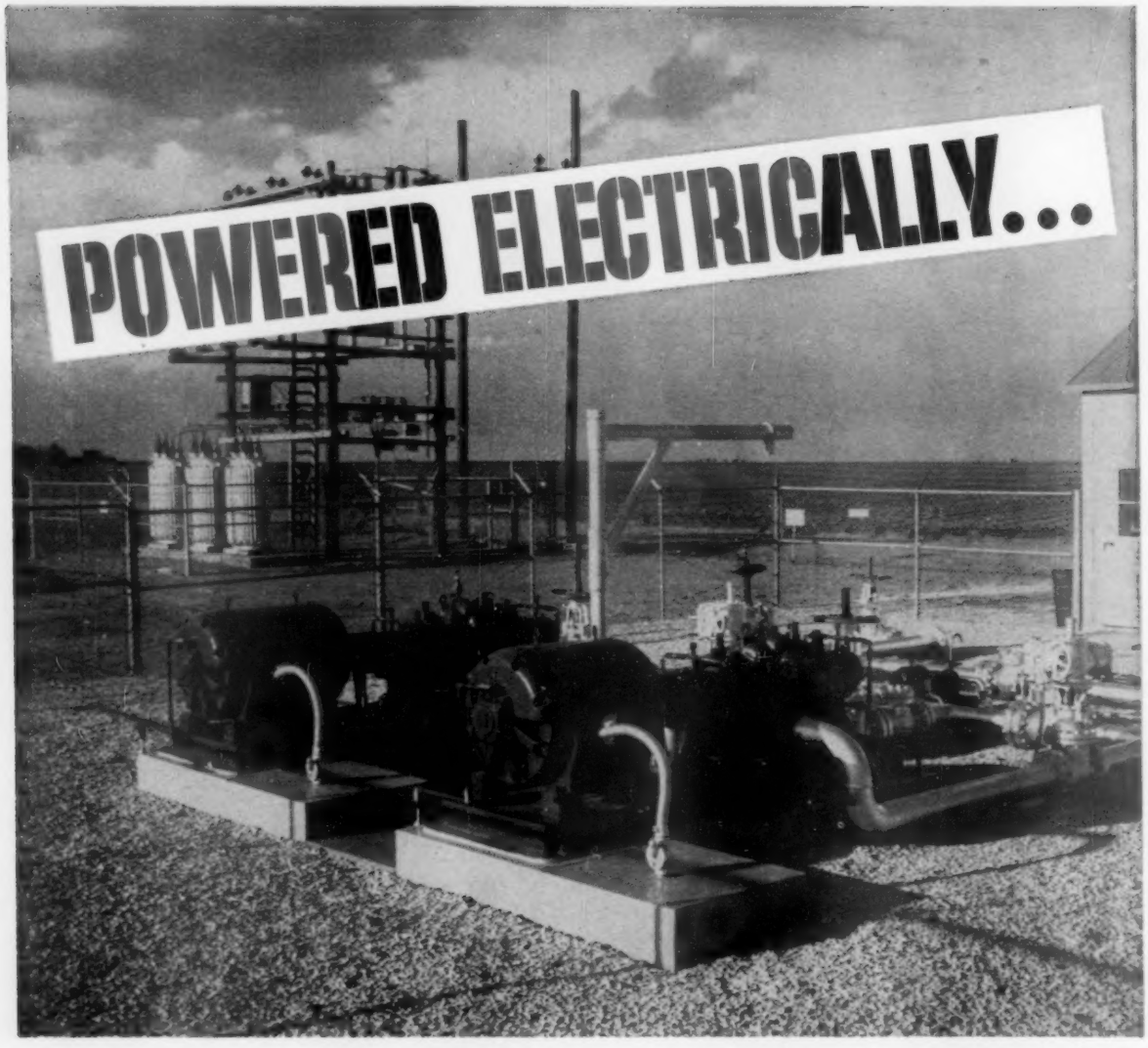
IDECO, Dallas, Tex.—Hydrair® and Power Rigs; Full-View® Masts; substructures; single, dual and Drive-In Rambler Rigs; blocks, swivels, rotaries; mud pumps; petroleum equipment and supplies.

Security

SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif. — Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.



REPUBLIC NATIONAL BANK BUILDING • POST OFFICE BOX 718 • DALLAS 21, TEXAS



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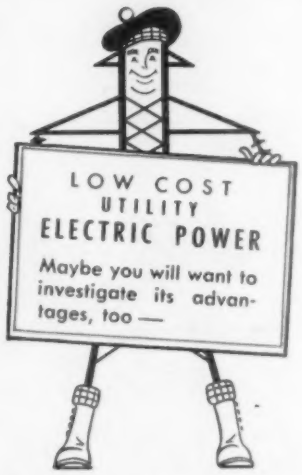
Whenever Low Cost Utility Electric Power is on the job ... you'll readily see the difference. Electric Power offers the operator a cleaner power source with the added advantages of LESS MAINTENANCE, LESS ATTENTION, and LESS MANPOWER. Automatic Remote Controls also mean greater efficiency... plus a more economical operation. Be sure of power when and where you need it... but be sure its Low Cost Utility Electric Power.



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PENROD LAND AND SEA DRILLING COMPANY

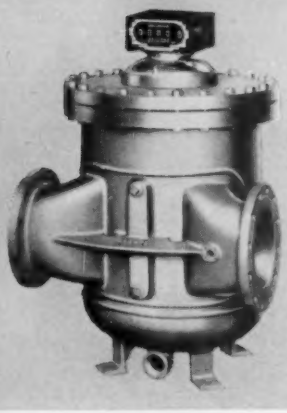
A. O. Smith . . . one

for meters

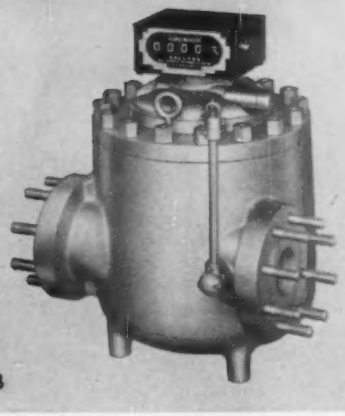
DUAL CASE METERS — for line working pressures of 150 to 2000 psi — balanced pressure on the metering unit . . . eliminate distortion . . . assure continuing high accuracy regardless of fluctuations of line pressure.

PHOTO A, large volume meter Model B-200, one of the largest positive displacement meters ever built, 2000 U.S. gpm.

PHOTO B, Model K-12, 120 U.S. gpm capacity for working pressures up to 2000 psi.



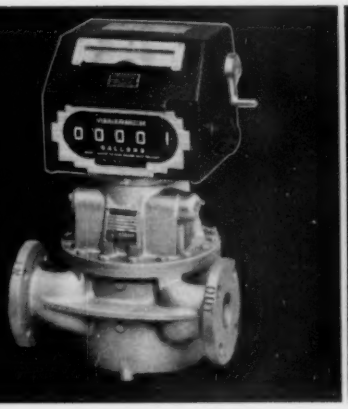
A



B

LINE METERS—for low pressure drop, precision measurement of bulk petroleum and other liquid products.

PHOTO C, Model S-12 straight-line meter is designed for line working pressures up to 150 psi . . . has capacity range 24 to 120 gpm.



C

PHOTO D, 90° meter, Models AS-35 or AS-50 have capacity ranges of 350 and 500 gpm.

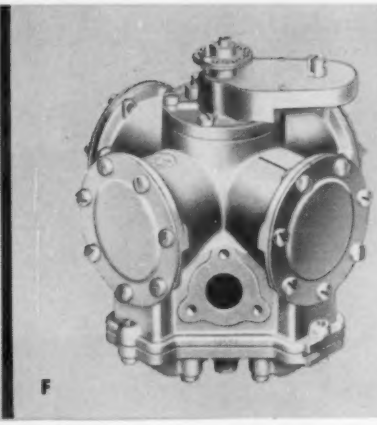
D

TRUCK AND INDUSTRIAL METERS — for fast, accurate, reliable delivery and tabulation where slight mistakes could add up to extensive losses.

PHOTO E, Model T-10 for tank truck and industrial use is designed for working pressures up to 150 psi and 100 gpm — other models with capacities ranging from 60 to 150 gpm.

E

PHOTO F, APM-2 meter gives extreme accuracy at low flow rates. Capacity to 20 U.S. gpm.



F

source, one responsibility

and accessories

A

C

B

D

COUNTERS

A. O. Smith meters can be equipped with a wide choice of counters to suit any application.

Shown at left are:

A. Large Numeral Reset Counter

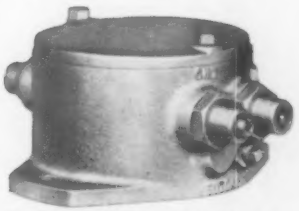
B. Large Numeral Counter-Printer

C. Horizontal Reset Counter

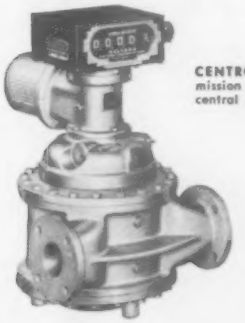
D. Horizontal Totalizing (non-reset) Counter

E. Set Stop Counter and Valve as installed on S-12 Meter (at right)

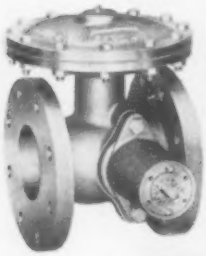
E



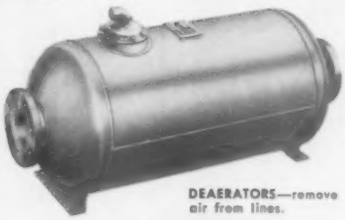
UNIT COMBINATOR — combines the output of two or more meters to give one total reading.



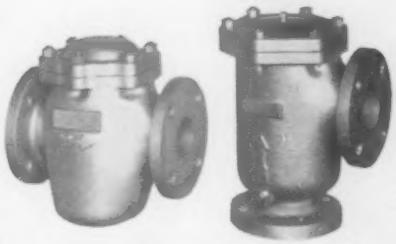
CENTROL — electrical transmission of meter readings to a central location.



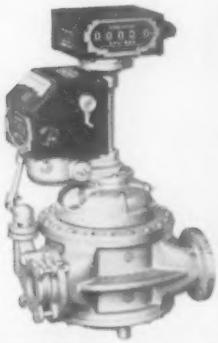
FLOW CONTROL VALVES—automatically limit the speed of flow through a line, preventing meter overspeeding.



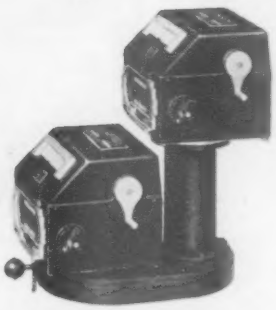
DEAERATORS—remove entrained air from lines.



STRAINERS — collect grit, scale, etc., from the line, prevent undue wear in meters.



TEMPERATURE COMPENSATOR AND DUAL COUNTER ADAPTER — gives both the gross meter reading and the "Temperature Compensated" net reading.



DUAL PRINTER-SHIFTER—makes possible continuous printed records of products without interrupting the flow.

Through research A.O. Smith *. . . a better way*

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KONTOL

...a proved gasoline plant corrosion preventive

In the gasoline plant, as well as in the refinery, Kontol corrosion inhibitors are preventing thousands of dollars worth of corrosion destruction. Kontol is not an experimental corrosion inhibitor, but has been used successfully in gasoline plants all over the country. In absorption systems less make-up oil is required since Kontol completely rids the system of corrosive products which discolor and contaminate the absorption oil. In addition to its corrosion inhibiting properties, Kontol's anti-fouling and its detergent characteristics serve to keep condensers and heat exchangers free from fouling. In many cases, the savings in cleaning costs even exceed the savings derived from corrosion prevention.

IN THE GASOLINE PLANT
KONTOL
PREVENTS CORROSION IN

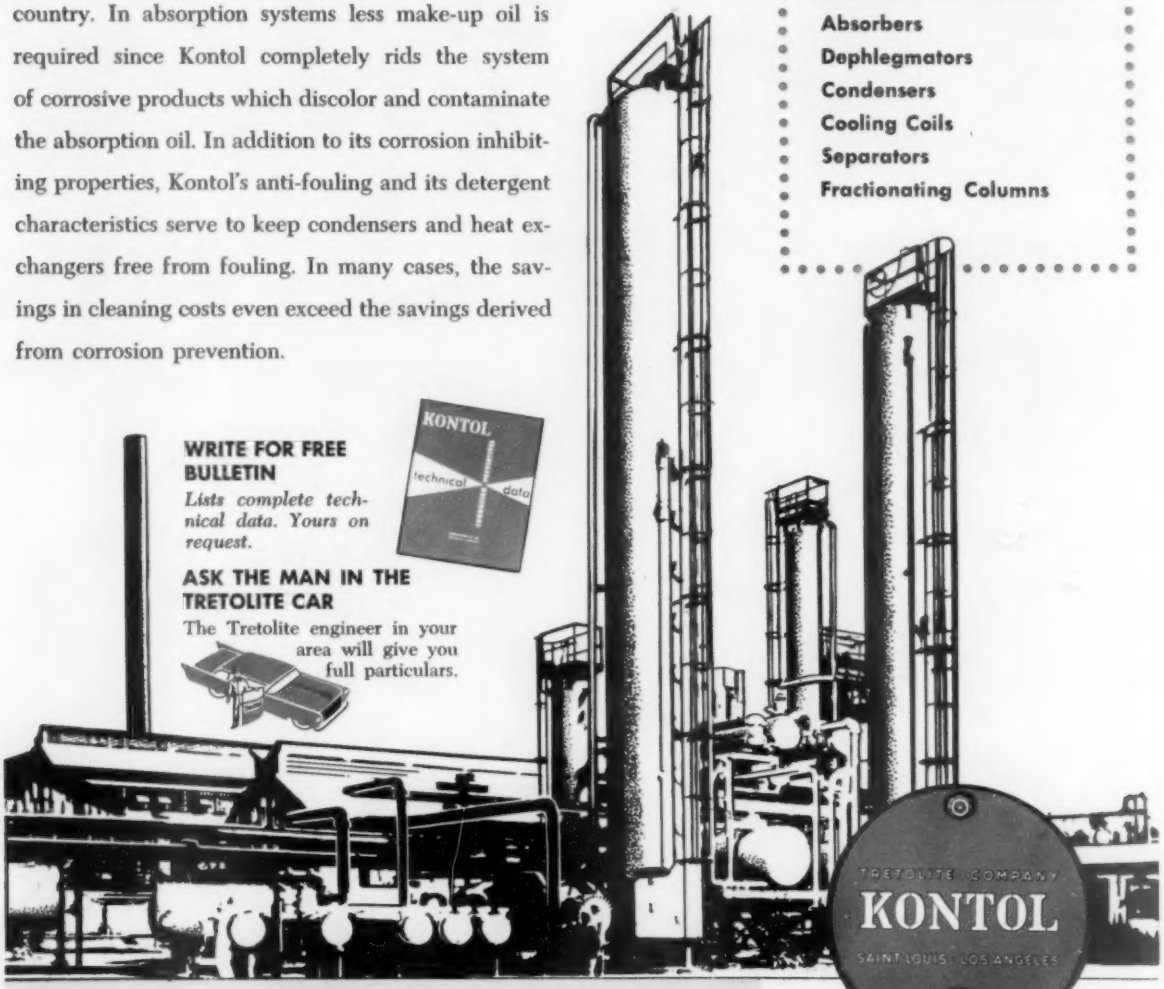
- Absorbers
- Dephlegmators
- Condensers
- Cooling Coils
- Separators
- Fractionating Columns

WRITE FOR FREE BULLETIN

Lists complete technical data. Yours on request.

ASK THE MAN IN THE TRETOLITE CAR

The Tretolite engineer in your area will give you full particulars.



TRETOLITE COMPANY

A DIVISION OF PETROLITE CORPORATION

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KG-57-1

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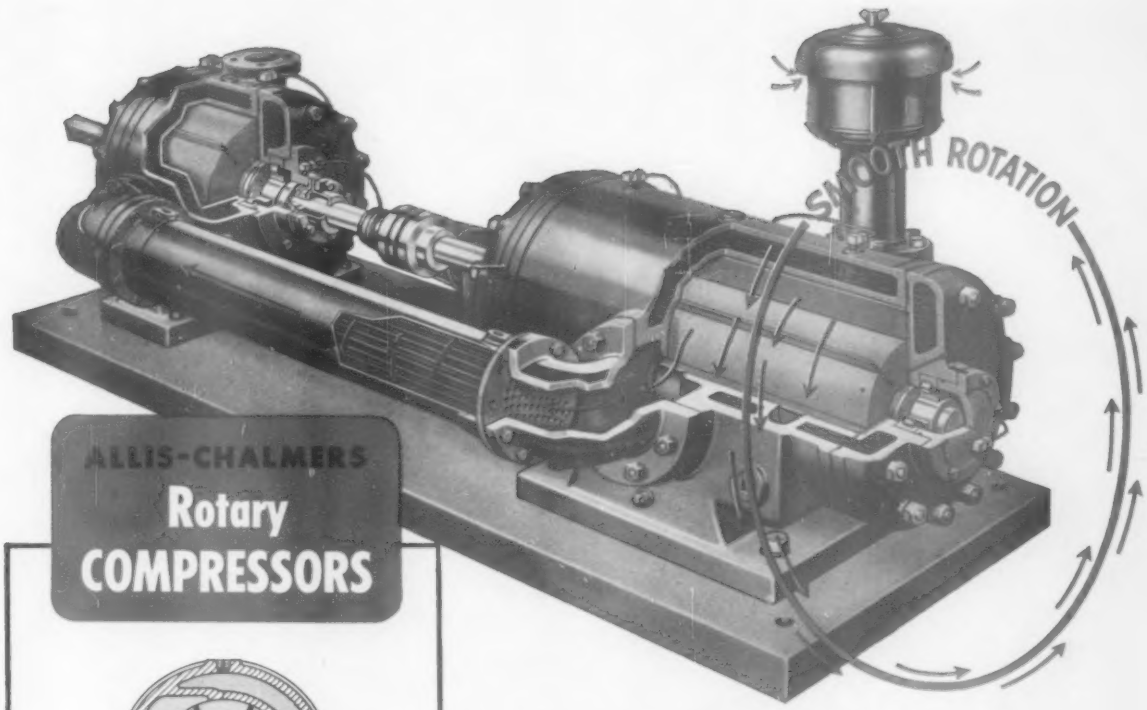
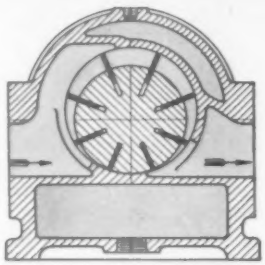
DEMULSIFYING, DESALTING, CORROSION PREVENTING, WATER DE-OILING, PARAFFIN REMOVAL, SCALE PREVENTING.



ALLIS-CHALMERS

Rotary COMPRESSORS



How Ro-Flo units operate: Centrifugal force moves vanes to outside wall to form air chamber.

Smooth-running Ro-Flo Compressors cut vibration, and provide...

Constant Efficiency

YEAR after year there is no change in the efficiency of a *Ro-Flo* compressor.

Efficiency always remains uniformly high even if parts wear. Here's the reason:

During operation the sliding vanes of the rotor (see cross section above) press against the cylinder wall to form air cells. Even if these vanes wear, the centrifugal force holds them in contact with the cylinder wall so that the air cell never changes and efficiency and air flow remain constant.

Rotary Means Smooth Operation

Smooth rotation cuts vibration ... eliminates need for heavy foundations. Small *Ro-Flo* units can be bolted directly to the floor. Large units need only a simple slab.

Maintenance is low. There is no wear and tear on compressors from shock and vibration ... no pistons and valves.

A Type and Size for Every Need

Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm. Two-stage units for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

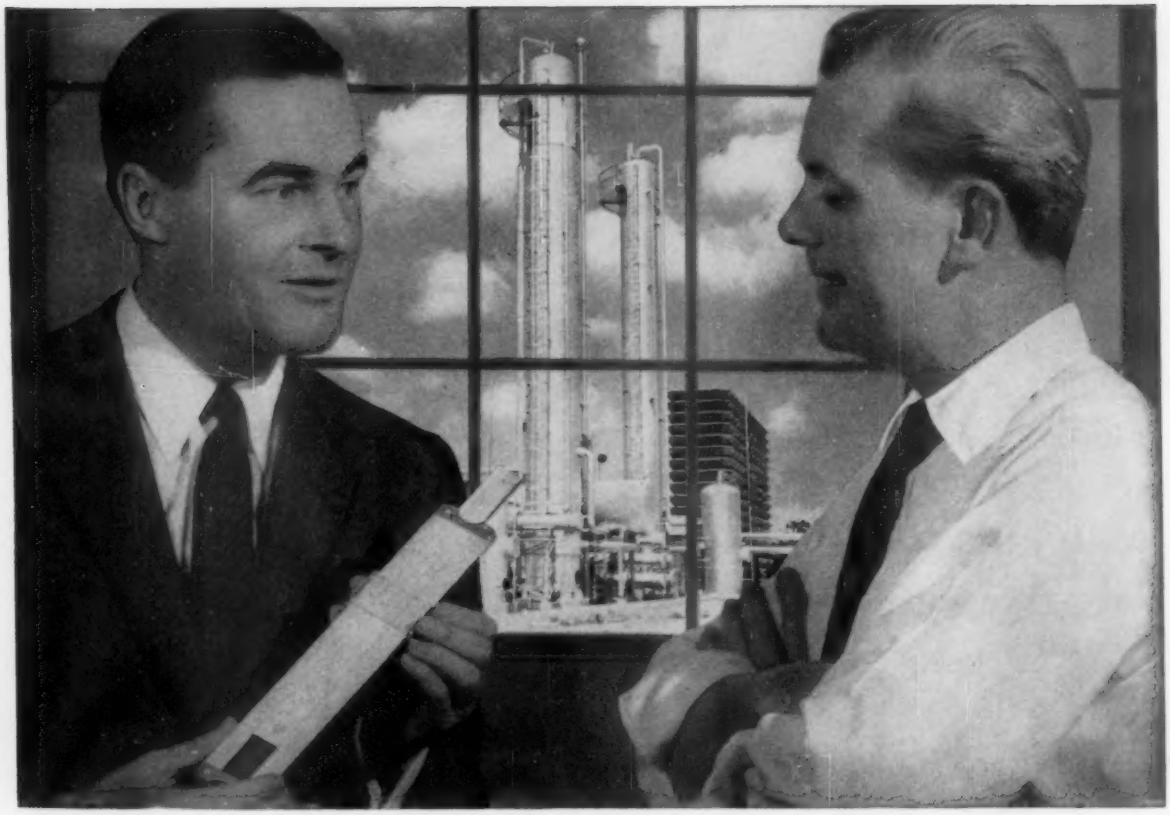
Single and two-stage vacuum pumps for vacuums to 0.3 inch mercury absolute from 22 to 5950 cfm.

GET INFORMATION — Call your nearest A-C office or write for bulletins 16B8244 (2-stage) and 16B8126 (1-stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

Ro-Flo is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-5134



You get more than

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CARBIDE AND CARBON CHEMICALS

Carbide and Carbon Chemicals Company
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30 East 42nd Street UCC New York 17, N. Y.

CARBIDE's mono- or diethanolamine give you excellent removal of CO_2 and H_2S. By converting the extracted H_2S to sulfur or H_2SO_4, you benefit by recovering a valuable product—thus reducing your operating costs.

CARBIDE's di- or triethylene glycol remove H_2O economically from gas streams. The low initial investment and low operating costs of glycol type plants provide minimum dehydration charges.

Plus Benefits

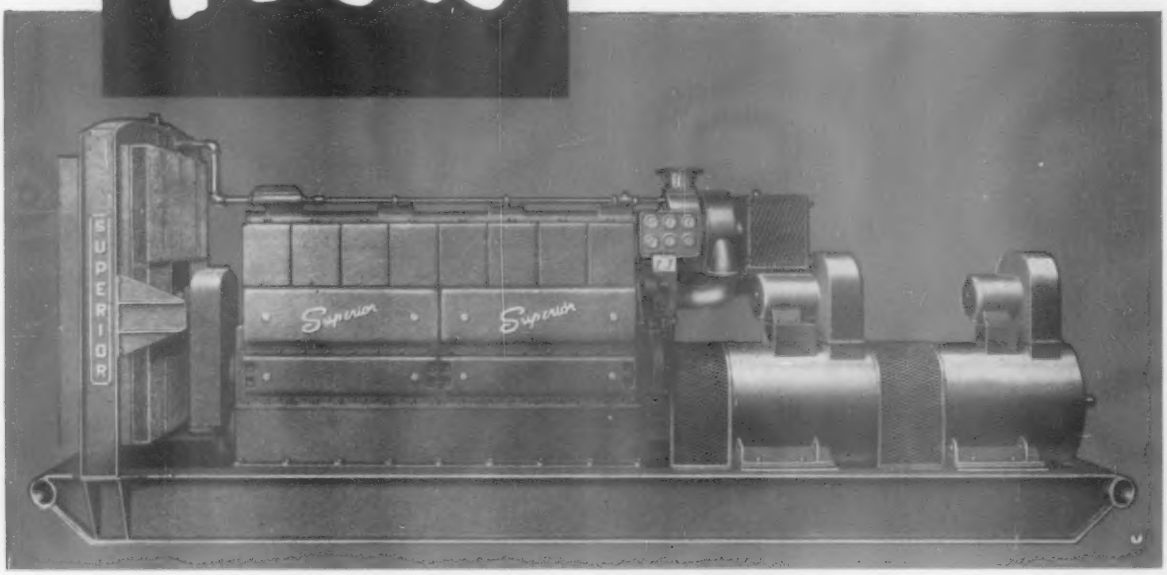
- Technical data gathered from 22 years experience producing and supplying gas treating chemicals. These data can help you in construction of new facilities, the enlargement of present equipment and in securing trouble free performance of existing plants.
- Technical help from field representatives and service laboratories.
- Fast delivery from warehouses located near major gas fields.
- Constant source of supply.

Find out for yourself how CARBIDE can help you. Write today to Carbide and Carbon Chemicals Company, Room 308, Department H, 30 East 42nd Street, New York 17, New York.

In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal. In Western Canada: Harrisons and Crossfield.

New

Lighter
Extremely Simple
More Powerful



WHITE'S DIESEL-ELECTRIC
drilling rig power plant

Now, combining new important advancements and design refinements, White offers a lighter, more compact package that provides extreme simplicity in arrangement and operation, and more power for deep drilling—land or offshore.

The highly developed components consist of two or more engine-generator sets, a minimum of three drive motors, and simple controls. White's well-known Superior oil field engine and a pair of time-proven 300 to 550 kw generators in tandem make up an engine-generator set. Total weight of one set alone is almost 8 tons lighter than comparable units! Simplification, compactness and lighter weight are greatly achieved through concentration of power in the heavy-duty drive motors. The largest units are rated 1000 hp continuous and 1250 hp intermittently, permitting use of only one motor for the drawworks, and one for each mud pump. This eliminates mechanical connections required in other plants where multiple motors are necessary. Use of fewer motors results in simplest controls, a lighter rig, and a net result of lower over-all cost. All components are standard production items, allowing greatest interchangeability, and smaller inventory of parts.

For complete information and advantages of White's diesel-electric operation, get White's Bulletin 101 available from all leading rig manufacturers, White field representatives, or through the White Diesel Engine Division.

White Diesel

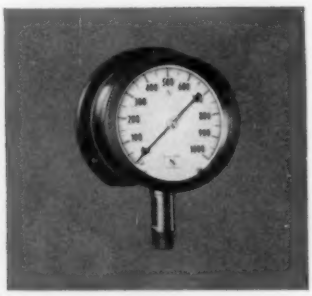
WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY
Plant and General Offices: Springfield, Ohio

Why does the BOURDON TUBE in the ASHCROFT DURAGAUGE insure sustained accuracy?

FOR FAST SERVICE, get in touch with your Industrial Supply Distributor. He is fully acquainted with Ashcroft Duragauges and their proper selection for all kinds of applications.

8 TUBE MATERIALS permit selection of the *best metal* for particular service conditions. These materials include phosphor bronze, alloy steels, "K" Monel, stainless steels, and beryllium copper.

Every Bourdon tube used in the Ashcroft Duragauge is extra-wide – highly sensitive to slight pressure changes. Socket and tip joints are welded or brazed, then stress relieved after assembly, to assure maximum safety and uniform structure for highest corrosion resistance and strength. Each tube assembly is "whip tested" at pulsating pressures approximately 50% higher than its pressure rating to insure calibration stability.



The Ashcroft Duragauge is available with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. A choice of case designs and materials, dial sizes and pressure ranges readily satisfy the most exacting requirements. Whatever the working pressures or corrosive conditions of your operations, specify Ashcroft Duragauges and be sure of highest sustained accuracy and long service life.

1850 ASHCROFT U.S.A.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

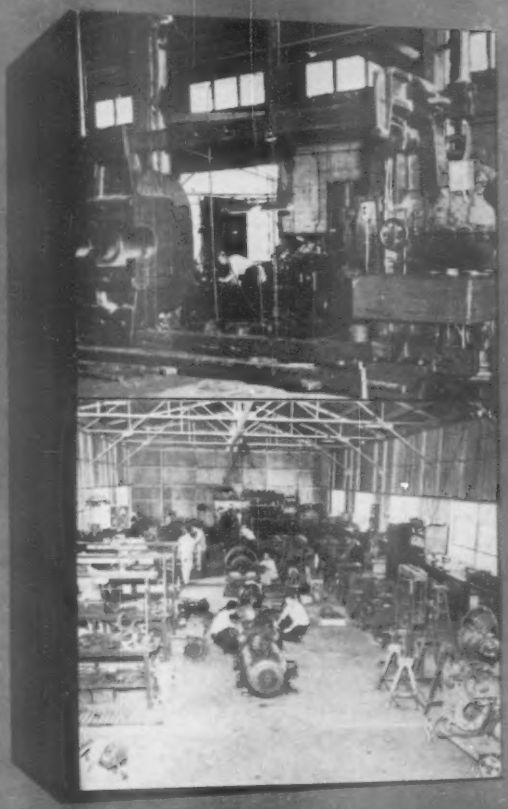
A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

MAXWELL MANNING MM&M MOORE INC. TRADE MARK

AVONDALE

a name you know for "Special Oil Services" . . .



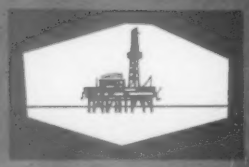
OIL FIELD MACHINE SHOP

A part of Avondale's growing diversification to meet the special requirements of the oil industry is reflected in their recently enlarged OIL TOOLS DEPARTMENT with the addition of a new Oil Field Machine Shop. Here the top combination of expert mechanics and modern machines makes it possible to offer fast and efficient service on all types of repair to oil tool drilling equipment . . . 24 hours a day, 7 days a week.

ELECTRICAL DEPARTMENT

Another Avondale service kept right up-to-the-minute to meet your special needs, this department is ready to meet your most exacting requirements in the electrical field. Motor rewinding is a specialty, but facilities are available for all types of electrical jobs. You will be pleased by the prompt turn-out of your work when you deal with Avondale.

. . . and many other "special services"—engineering, research, design, fabrication, conversion and, of course, all types of construction of oil marine equipment.



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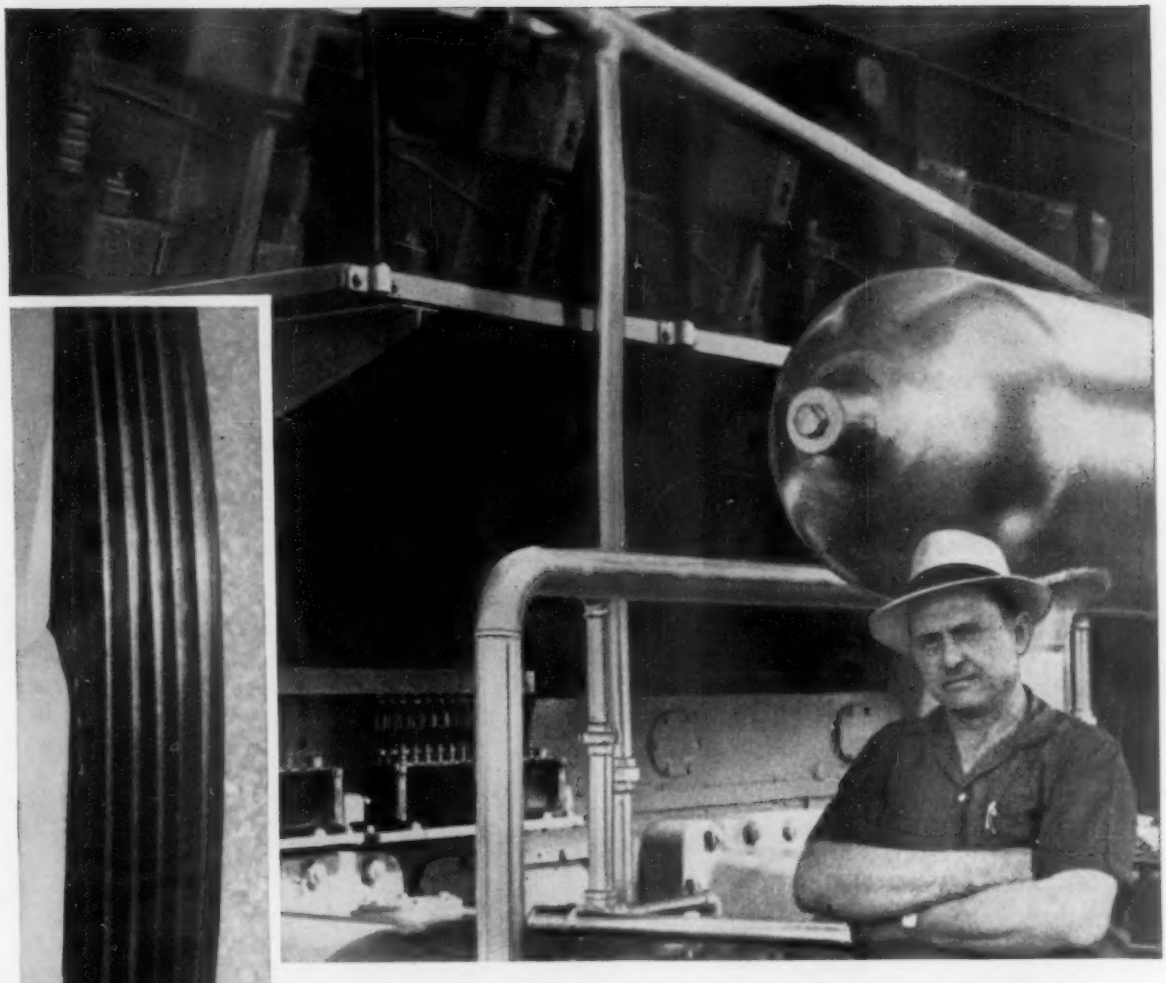

Long, Long Wear and Completely Dependable Performance from

Pedrick PISTON RINGS

The Michigan-Wisconsin Pipe Line Co. is another user of Pedrick Engineered Sets of piston rings to prove this. E3905 Sets are installed in Cooper-Bessemer GMW-10 natural-gas engines at the Edgar G. Hill compressor station at Guymon, Okla. Harry Crouch, superintendent, stands beside one of these engines in the picture above. The picture to the left is from an unretouched photo of five of the taper-face compression rings recently removed from the engine during routine maintenance. The bright surface is the area of wear. Note that it does not go even half way across the face of the rings after 27,000 hours of steady round-the-clock operation at full load! That's less than .0025 in. radial wear. The Pedrick *conformable* Formflex oil rings in this installation showed equally low wear. The rings still are in condition to give more than double the length of service already achieved! If you want to be more sure of minimum wear of rings and cylinder liners, if you would like to cut your lube-oil consumption to the bone, if dependability of performance under full load without interruption is important to you, then use Pedrick Engineered Sets of piston rings in your engines from now on.

WILKENING MANUFACTURING CO., Philadelphia 42 and Toronto 2

Confidence...

is essential in R/A logging, too

Confidence is the key in your choice of a surgeon, guided by his experience, his knowledge, his diagnosis and his choice of instruments. Confidence is also the key when you choose Welex R/A Logging based on experience and skill gained from unlimited field work to insure competent interpretation of your radioactivity log and complete assurance of the availability of all the latest equipment. Your confidence in these tools has made Welex a leader in R/A Logging:

3⅜" O.D. Scintillation Counter: the newest and latest logging instrument in use today.

3⅜" O.D. Ionization Chamber: a process with a history of proved effectiveness in R/A Logging.

2⅜" O.D. Geiger Counter: a tool developed for slim hole logging operations.

1¾" O.D. Geiger Counter: to log through-tubing in permanent type completions.

These tools record simultaneously Gamma Ray, Neutron and Casing Collar Logs. The Gamma Ray and Neutron Logs exhibit excellent repeatability and are readily adaptable to quantitative analysis. The Casing Collar Locator picks up collars in flush joint pipe even in the heaviest muds and in extremely high temperature. All Welex R/A Logging instruments, like those of a surgeon, insure you the best possible results.

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valves, fittings and flanges by Vogt

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CHEMICAL PLANTS

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USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

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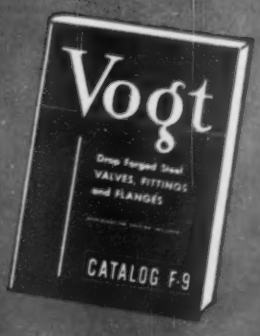

HENRY VOGT MACHINE CO. 75th Anniversary LOUISVILLE, KY.

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

Applying NO-OX-ID Coating and Wrapper by Traveliner.

Mill- or yard-wrapping for long-term protection at its best.

Hand application of NO-OX-ID Cold Coating.

NO-OX-ID "C-M" Casing Filler protects casing and carrier pipe under highways and railroads.

NO-OX-ID coating-wrapper combinations are the versatile answer to every kind of pipeline protection

Whether you are installing distribution or transmission lines—whether you are working over rough or smooth terrain, there is a NO-OX-ID Coating and Wrapper Combination to give the right protection.

On mill-wrapped pipe, NO-OX-ID Coating, Wrapper and Service Coat protect from mill to ditch. NO-OX-ID can be applied over the ditch by Traveliner using less material and equipment. Hand-applied on short line installations, service lines or special fittings, NO-OX-ID goes on fast. No noxious fumes.

Leading pipeline contractors and utilities rely on versatile NO-OX-ID Coating and Wrapper Combinations. Consult with your Dearborn Pipeline Engineer. He will help you select the right combination for your next pipeline job.

New NO-OX-ID catalog

Just off the press. This 12-page illustrated catalog tells how NO-OX-ID combinations fit job requirements. Your copy is ready...USE THE COUPON.

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Dearborn® NO-OX-ID

Protecting Metal Against Corrosion for 70 Years

For Petroleum Pumping and Processing

Century

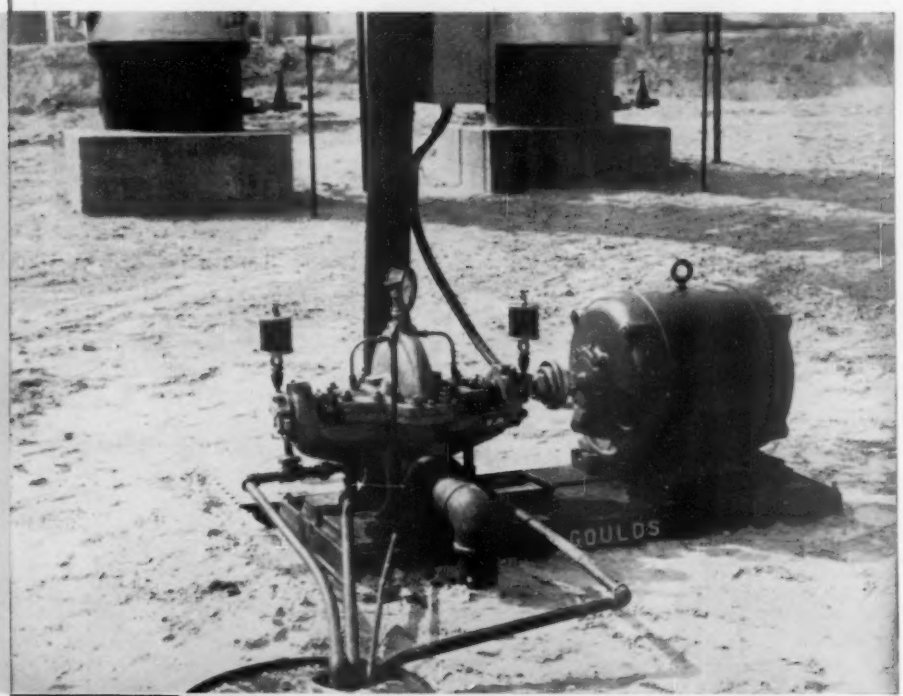
MOTORS PROVIDE DEPENDABLE POWER... FOR YEARS TO COME

There's a complete line of Century Motors engineered and built to withstand the tough requirements of the oil producing and refining industries.

Performance-Rated Century Motors are available with Weather-Gard frames which protect against rain, snow, sleet and falling objects—and with screens to keep out rodents.

Totally Enclosed and Explosion Proof Types are available for dusty and explosive atmospheres... and you have a wide range of choice in starting and running characteristics to meet your needs. Check with your supply store, or Century branch office.

At Kilgore, Texas, this 25 HP Century Motor drives a sump pump at production battery on townsite wells.



Write for your copy of Century's Oil Industry Bulletin 14-141-P1.

Performance Rated©
MOTORS
1/20 to 400 H.P.

CENTURY ELECTRIC COMPANY

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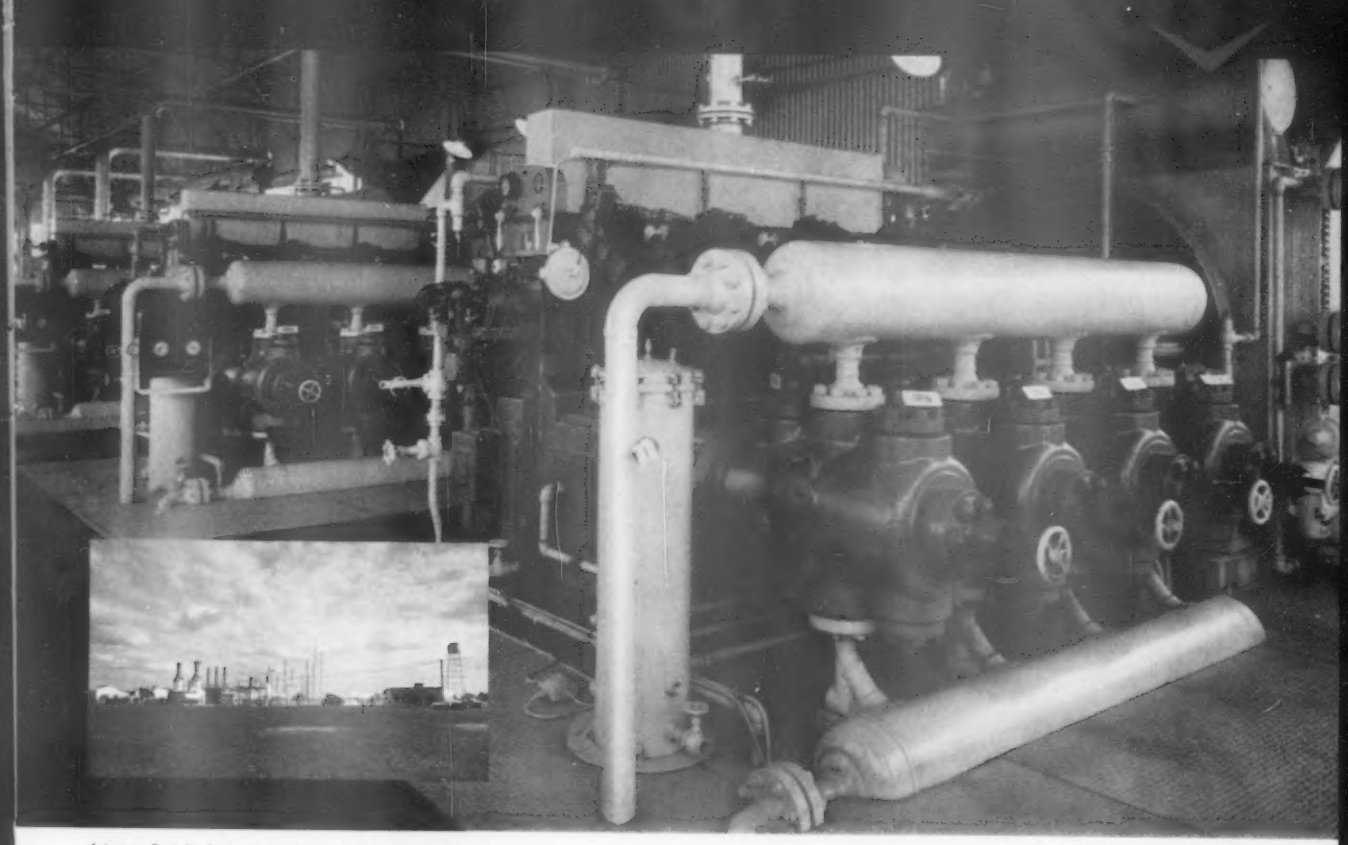
BEAIRD-INGERSOLL-RAND Packaged Compressor Plant



Arkansas Fuel Oil Corporation's Panola Gasoline plant equipped with three Beaird-Ingersoll-Rand 220 h.p. 8JVG packaged compressors. Units have Young radiators with lubricating oil coolers and gas after-coolers and all necessary controls for unattended operation. Other sizes 110 to 660 h.p.

Packaged Compressors provide—

FLEXIBLE OPERATION FOR LARGE GASOLINE PLANT

Arkansas Fuel Oil Corporation operates this large gasoline plant in the Panola Field just south of Carthage, Texas. Natural gas processed in the plant is picked up from 18 wells by three Beaird-Ingersoll-Rand 8JVG 220 h.p. packaged compressor units. Boosting 8 to 12 million cubic feet per day the units use one stage of compression to raise the gas from 550 psig input to 1100 psig.

To assure maximum flexibility and continuous operation, Arkansas Fuel Oil installed a number of packaged units rather than one large compressor of equal horsepower. Plant pressures and operations can be maintained, when necessary, by two of the units while the third is shut down for maintenance or repair. This permits plant production to be held to scheduled capacity at all times.

As wellhead pressures drop off the compressors can be changed on location to two-stage operation or additional units can be placed on the line. The operating flexibility of this multiple unit packaged compressor station will prove even more valuable as the field approaches depletion. When no longer needed the compressors can be transferred to other service as complete units with little or no change.

Let us show you how economically Beaird-Ingersoll-Rand packaged compressor plants can be added to your compressor station.

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana

BEAIRD

LOWEST COST PER HORSEPOWER INSTALLED

SALES OFFICES: *Shreveport, New Orleans, Louisiana • Dallas, Houston, Corpus Christi and Midland, Texas • Tulsa, Oklahoma • Denver, Colorado • Los Angeles, California • Cie. Ingersoll-Rand, Paris, France • Caracas, Venezuela.*

BEAIRD FITTINGS...

THE RIGHT TURN FOR SEAGOING OIL!

Weighing twenty six hundred pounds each, these 24" Beaird cast steel fittings have gone to work delivering Venezuelan oil to waiting tankers. Another example of precision manufacturing from blueprint to finished product, the big cast steel flanged elbow fittings were produced to exacting specifications by Beaird's machining division. One of five divisions serving the oil, gas, petro-chemical and construction industries, the machining division offers its customers the benefits of the integrated facilities and know-how of the entire Beaird production team.

BEAIRD

Let us quote on your next outside machining or special product requirement. Write: The J. B. Beaird Company, Inc., Shreveport, Louisiana.

THE J. B. BEAIRD COMPANY, INC.

MACHINING
MANUFACTURING
STEEL WAREHOUSE

PACKAGED COMPRESSOR PLANTS | CAST STEEL FITTINGS | PRESSURE BULK STORAGE | ANHYDROUS AMMONIA EQUIPMENT | LP-GAS SYSTEMS

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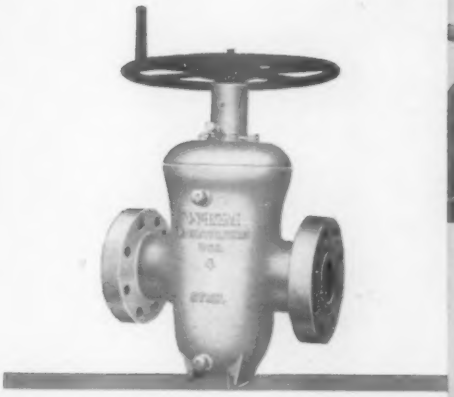
● There's no need to dismantle completely a christmas tree to remove a **W-K-M** Valve for factory overhauling—with the consequent loss of several day's production. **W-K-M** Production Valves can be completely reconditioned right on the tree.

W-K-M VALVES CAN BE OVERHAULED ON THE TREE

to save you valuable time and production

All of the working parts — bonnet, stem and gates — may be removed in one simple operation. Seats can be replaced, if necessary, with **W-K-M**'s hydraulic seating tool. Re-assembly, after thorough cleaning, repairing or replacement of parts, is equally easy. When overhauling is completed your **W-K-M** Valve is as good as new—and usually the job takes only an hour.

For your convenience **W-K-M** servicemen who specialize in this work are available at every active field.



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PLANT: MISSOURI CITY, TEXAS

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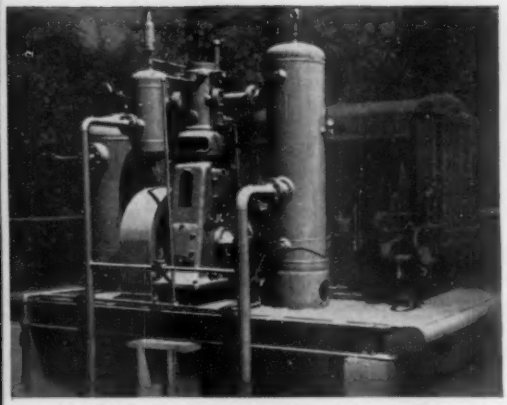
MANUFACTURERS OF W-K-M GATE VALVES · acf LUBRICATED PLUG VALVES · KEY-KAST ALLOY STEEL PIPING FITTINGS · KEY RETURN BENDS AND FITTINGS

THE ONLY MODERN-DESIGN COMPRESSORS FOR GAS BOOSTER OPERATION



Joy WGB-110 Gas Compressor. Inlet pressure 150 psig; Discharge pressure 500 psig. Capacity 1.028 MMCFD. "Packaged" by McNamar Boiler & Tank Co., Tulsa.

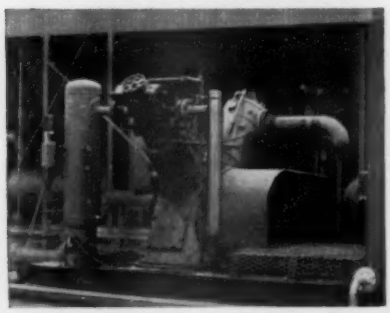
JOY *Packaged* GAS COMPRESSORS

Modern Joy Packaged Gas Compressors are backed by a century-old reputation for low maintenance and long service. These *time-proved* features make Joy Compressors the most reliable for gas gathering, repressuring, or gas lifting:

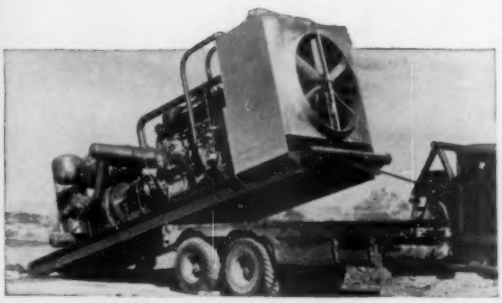
- **Field-replaceable cylinder liners.**
- **Field-replaceable crosshead guides.**
- **Patented Joy "Dual-Cushion" valves.**
- **Full force-feed lubrication.**
- **Anti-friction main bearings.**

Joy Gas Compressors are available in space-saving vertical, V-type, and semi-radial designs . . . single or two-stage units with cylinder sizes from 3" to 13½". Four different frame types accommodate a power range of 50 to 400 HP.

For the most efficient compressor for your needs, consult a Joy Engineer or write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



Joy WNB-112 Gas Compressor. Inlet pressure 35 psia; Discharge pressure 665 psia. Capacity .85 MMCFD. "Packaged" by Oil & Gas Supply Company, Houston.



This photo of a Joy WNB-114 Gas Compressor Package being unloaded onto concrete pad clearly illustrates portability of unit. Inlet pressure is 5 psig; Discharge pressure is 150 psig. Capacity 2 MMCFD. "Packaged" by McNamar Boiler & Tank Co., Tulsa.

Write for FREE Bulletin 84-31

Consult a Joy Engineer

FOR PORTABLE ROTARY DRILLS,
AIR COMPRESSORS, GAS GATHERING
COMPRESSORS, PORTABLE LIGHTING LINES

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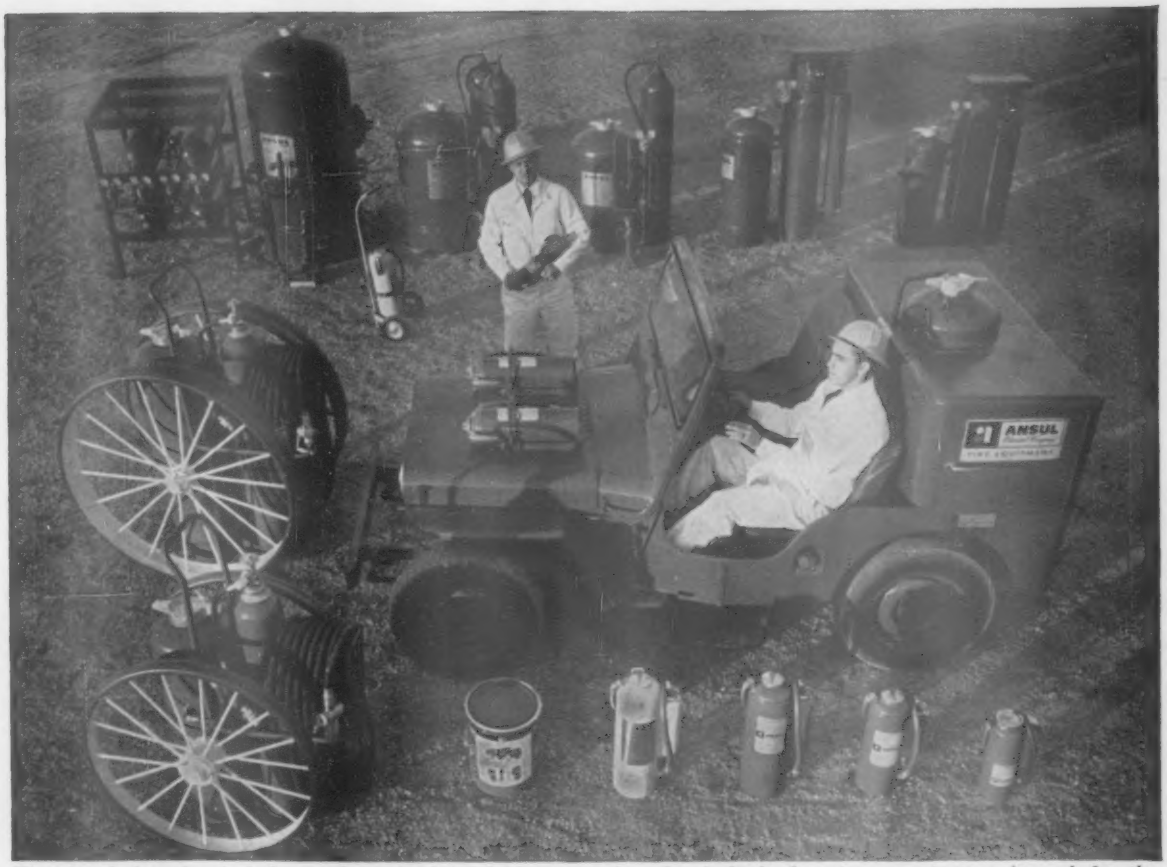
JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885



The Ansul dry chemical fire equipment pictured above includes portable hand units, wheeled and stationary units and a jeep installation. Ansul also manufactures automatic dry chemical piped systems, custom engineered for the hazard. Ansul equipment is listed and approved by Underwriters' and Factory Mutual Laboratories.

Only Ansul offers a Five Year Equipment Warranty

Your assurance of fast, dependable fire protection

For you, the buyer of fire equipment, Ansul's important 5 year warranty means many extra years of fast, dependable protection. It also means freedom from costly maintenance checks and repairs.

Special design and construction features make this warranty possible. Ansul's *weather-tight* construction keeps out moisture, resists corrosion. *Patented nozzles* deliver the right kind of stream for your hazard. A *sealed pressure cartridge* puts Ansul's "Plus Fifty" dry chemical to work immediately—no delay or lag. Finally, *rugged construction* makes it possible for Ansul equipment to give peak performance under the toughest operating conditions.

Call the Ansul Man!

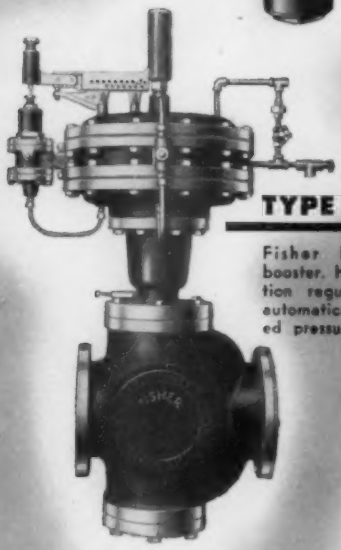
Get in touch with your local Ansul man through the "yellow pages" or write ANSUL CHEMICAL COMPANY, Fire Equipment Division, Dept. F-93, Marinette, Wisconsin. *Write Ansul for your copy of new Fire Equipment Catalog.*

ANSUL

FISHER® Offers Most GAS

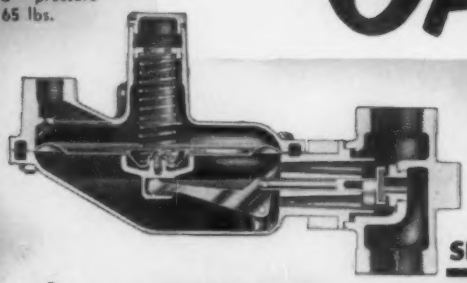
TYPE 99

Self-contained pilot operated gas regulator for small border stations and industrial applications. 2" size only. Reduced pressure range 4 oz. to 65 lbs.



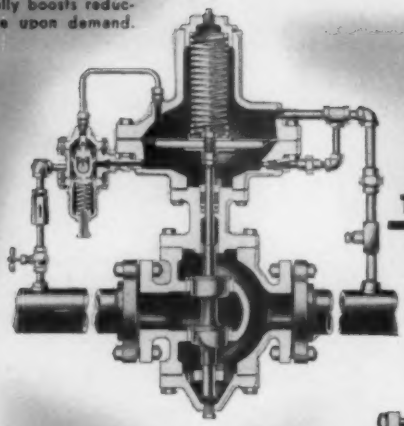
TYPE 840

Fisher King pressure booster. High pressure station regulator unit which automatically boosts reduced pressure upon demand.



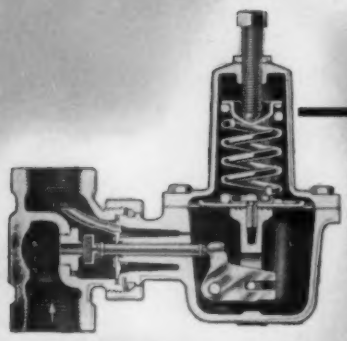
SERIES S100

Standard gas service regulator with or without integral relief valve, bug-proof vents. Also available with safety shut-off feature. Sizes ¾", 1", 1¼" and 1½".



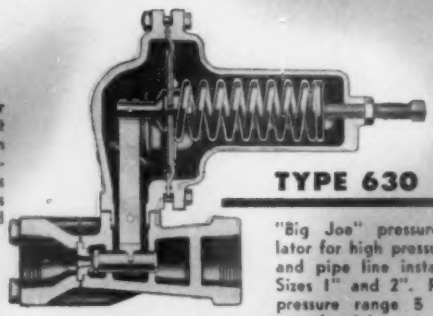
TYPE 880

Pilot loaded, pressure balanced high pressure station regulator, ideal as town and border station regulator for dependability and stable metering. Pressures to 600 psi inlet, 250 psi outlet. Sizes 2" to 10", iron or steel.



TYPE 620

Pounds to pounds regulator especially suited for first stage reduction on farm taps. Also designed for industrial gas applications where good regulation is required. Sizes ¾", 1" and 1¼".



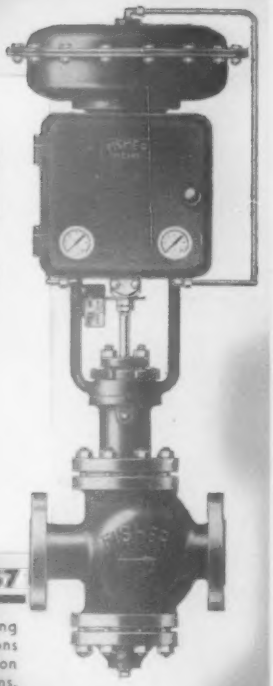
TYPE 630

"Big Joe" pressure regulator for high pressure field and pipe line installations. Sizes 1" and 2". Reduced pressure range 5 to 200 pounds. Inlet pressure up to 1500 lbs.

FISHER®

LEADS THE INDUSTRY IN RESEARCH
FOR BETTER GAS PRESSURE CONTROL

You The Industry's *Complete* Line of REGULATORS

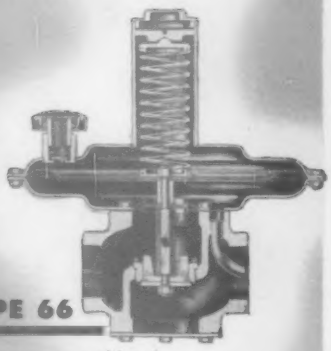


Fisher Governor Company's wide variety of regulators handle control applications ranging from the natural gas well head to burner utilization. Illustrated are just a few of the varieties of construction.

This complete Fisher line of regulators for the gas industry includes District Regulators, high, low and intermediate pressure — Distribution Regulators — House Service Regulators — High Pressure Field Regulators — Boiler Gas Fuel Governors — Booster Regulators — Safety Shut-Off Regulators — Town Border Station Regulators — Industrial Gas Regulators — Meter Run Regulators.

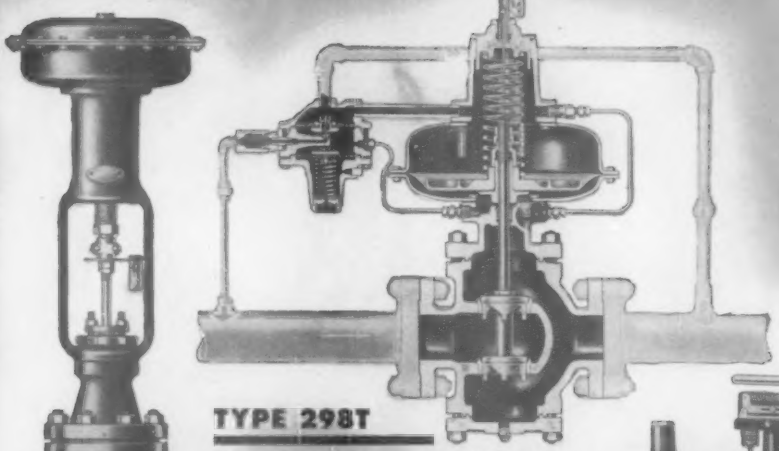
TYPE 4100U-657

High pressure reducing valve for border stations — high pressure regulation and industrial applications.



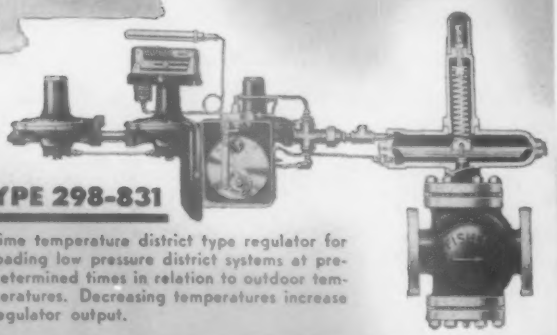
TYPE 66

Low pressure sensitive industrial regulator for inlet pressures up to 5 lbs. Reduced pressure "WC to 1 lb. Sizes 2", 3", 4".



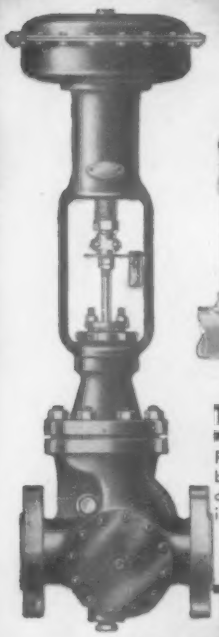
TYPE 298T

Pilot operated gas pressure regulator, non-bleed construction, for border stations and district regulator applications. For low and intermediate pressures, sizes 2" and up.



TYPE 298-831

Time temperature district type regulator for loading low pressure district systems at predetermined times in relation to outdoor temperatures. Decreasing temperatures increase regulator output.

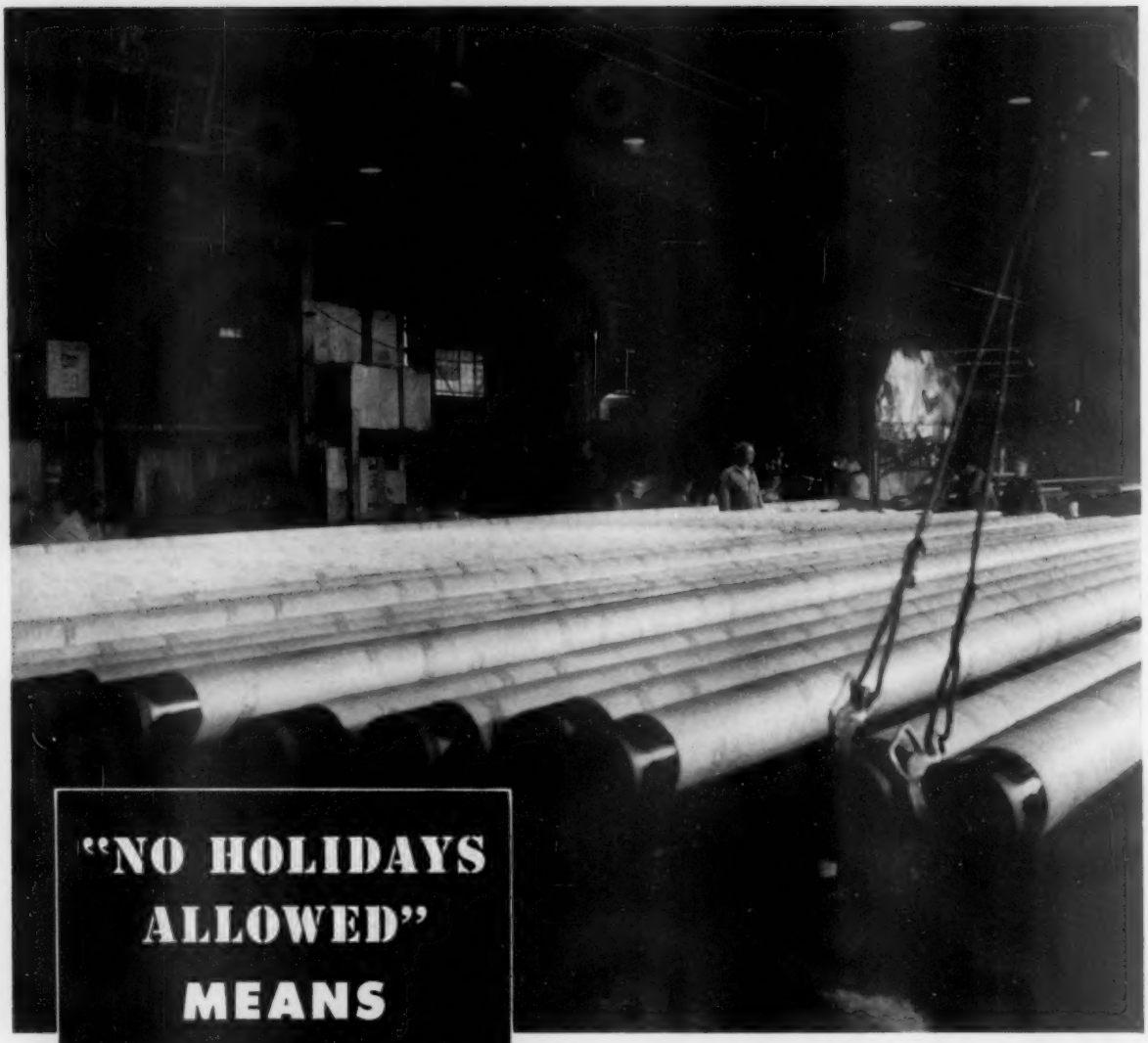


TYPE 657-L

Diaphragm control valve for automatic operation of multiple tube gas measurement meter runs. Features extremely low pressure drop and tight shut-off.

FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO



"NO HOLIDAYS ALLOWED" MEANS BETTER PIPE PROTECTION!

When is a holiday not a vacation? When it's an imperfection in the coating and wrapping. Such a weakness cannot possibly escape detection at Hill, Hubbell. For in a final step, all Hill, Hubbell processed pipe goes on inspection skids as shown above. Then each square inch is carefully examined by an electronic Holiday Detector before the pipe leaves the plant. One of many quality controls developed by Hill, Hubbell, the use of Electronic Holiday Detectors is simply—

Another "first" pioneered by the first name in pipe protection

FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

HILL·HUBBELL & COMPANY

DIVISION OF GENERAL PAINT CORP. • 3091 MAYFIELD ROAD, CLEVELAND 18, OHIO

"What a difference the frame makes!"

An Autocar frame starting down the assembly line in the upside-down position which permits easy mounting of transmission and rear axles.

Autocar's heat-treated alloy steel frame means many more years of low-cost operation

You need two qualities in a heavy-duty truck frame, and Autocar has them both.

First, the frame must be *rigid* enough to hold major components permanently aligned or else the whole truck will be working against itself and wear out rapidly.

Second, it must be *flexible* enough to travel over rough country without straining itself beyond the springback point.

Rigid but flexible frames provide Autocars with a sound foundation for a long and profitable operating life. But they're only one of Autocar's exclusive features that pay off for every Autocar user.

LOOK AT THESE FEATURES, TOO

Custom building makes your Autocar fit your particular hauling conditions.

Nut and bolt construction with lockwashers under head and nut holds fast but permits easy removal of parts for repairs.

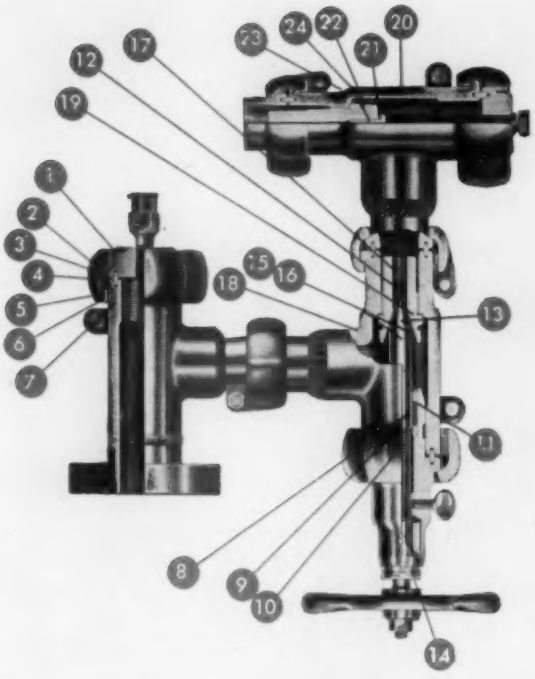
Balanced drive shaft and balanced front end prevent wear from vibration.

Find out how Autocars can step up efficiency in your heavy-duty hauling. See your White-Autocar distributor or write direct to the factory.

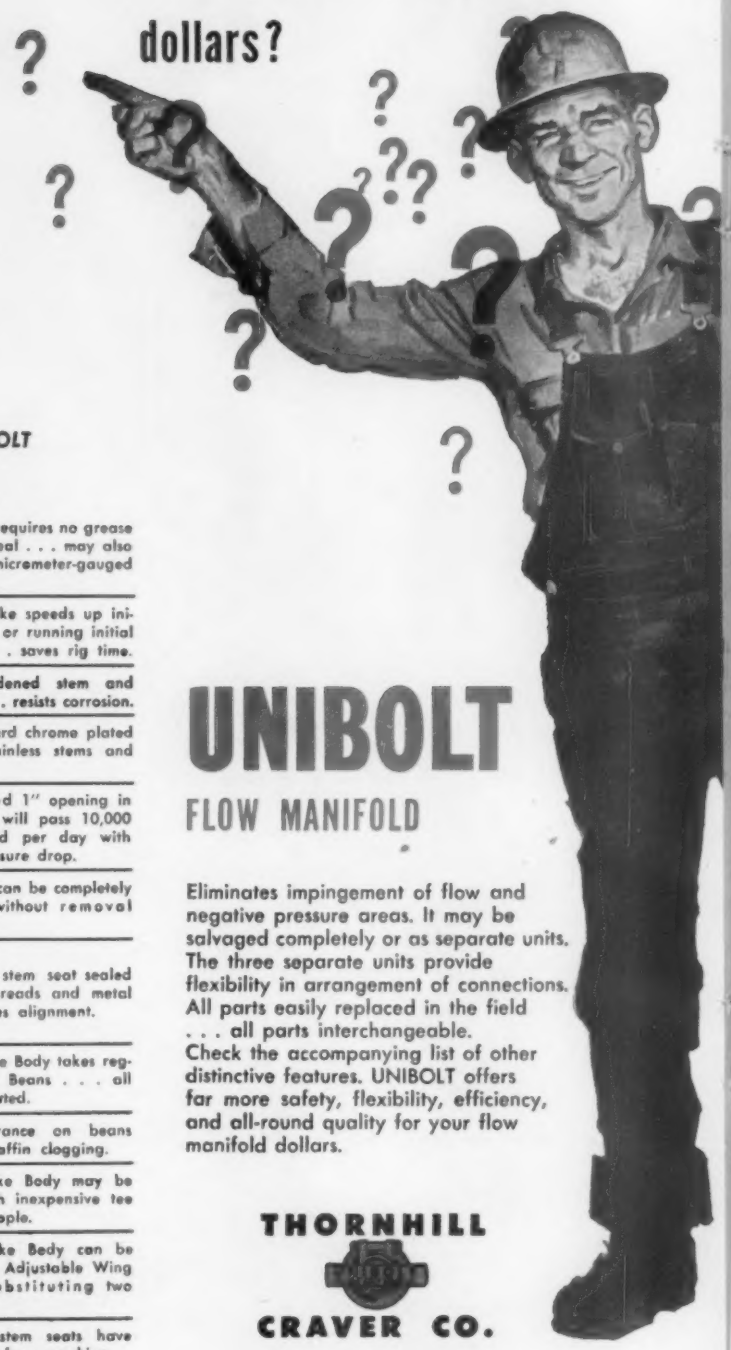
Autocar

AUTOCAR TRUCKS

Autocar Division of The White Motor Company
Exton, Pa.



Are you getting all of these important features for your flow manifold dollars?



These are the "Extras" that make UNIBOLT the best buy of all manifolds

1	Tee cannot be accidentally opened.	13	Wing Valve requires no grease to effect a seal . . . may also be used as micrometer-gauged flow bean.
2	No exposed threads . . . no accidental damage.	14	Variable choke speeds up initial clean-up or running initial flow tests . . . saves rig time.
3	Concealed seat in groove . . . no accidental damage.	15	Nitride hardened stem and stem seat . . . resists corrosion.
4	All metal seat . . . not affected by high or low temperature.	16	Choice of hard chrome plated or "SA" stainless stems and seats.
5	Lubricators, bottom hole pressure adapters, and valves easily attached to Unibolt connection.	17	Unrestricted 1" opening in Wing Valve will pass 10,000 bbls. of fluid per day with 100 lbs. pressure drop.
6	2"—3000 lb. wp Unibolt 28% stronger than 2"—ser. 900 flange.	18	Wing Valve can be completely overhauled without removal from tree.
7	Unibolt stronger than tubing threads . . . ideal for working trees with welded lift nipple. Tubing threads in tee if desired.	19	Wing Valve stem seat sealed by power threads and metal gasket assures alignment.
8	Stem packing needs no tightening.	20	Positive Choke Body takes regular or "X" Beans . . . all beans flow-rated.
9	Stem turns freely under high pressures.	21	Shaped entrance on beans prevents paraffin clogging.
10	Threads on stem not exposed to external or internal damage.	22	Positive Choke Body may be replaced with inexpensive tee and cage nipple.
11	Full 2½" pilot for true stem alignment and rigidity.	23	Positive Choke Body can be converted to Adjustable Wing Valve by substituting two parts.
12	Streamlined flow — no obstructions . . . no turbulence.	24	Beans and stem seats have external hex for wrenching.

UNIBOLT

FLOW MANIFOLD

Eliminates impingement of flow and negative pressure areas. It may be salvaged completely or as separate units. The three separate units provide flexibility in arrangement of connections. All parts easily replaced in the field . . . all parts interchangeable. Check the accompanying list of other distinctive features. UNIBOLT offers far more safety, flexibility, efficiency, and all-round quality for your flow manifold dollars.

THORNHILL CRAVER CO.

P. O. BOX 1184
HOUSTON, TEXAS

Weeds are a hazard you can't afford

Get rid of them with Baron, Radapon and other Dow weed killers

Inside this plant, every safety precaution has been taken. Thousands of dollars and hundreds of man-hours have been spent to prevent fire.

Outside—only a few feet away—stands a tank car filled with flammable materials. Dry, oil-soaked weeds cluster around it. If that tank car goes, all the "no smoking" signs in the world won't keep fire out of the plant!

But fire is only one hazard. Oil or other liquids spilled on the weeds may cause a workman to slip and severely injure himself. Weeds can also interfere with switches, hide lost tools from view and generally obstruct operations.

Prevent these hazards the easy, low-cost way with Baron*, Radapon* and other Dow weed killers. Your own men can do the job, or professional contractors will assume full responsibility. Let us send you more information and the name of a qualified distributor near you.

Write for free new booklet, "Industrial Vegetation Control". THE DOW CHEMICAL COMPANY, Midland, Michigan, Department AG 313.

*Trademark of The Dow Chemical Company

YOU CAN DEPEND ON DOW

7 wells in a year . . . total footage 79,500 . . . no trouble from this

HP-18000 WHELAND PUMP

Installation view of the Wheland HP-18000 owned by Oil Production Maintenance, Inc., Houston, Texas. Left to right: Messrs. J. K. Butler, President; Tracy East, Wheland Serviceman; "Pop" Woods, Tool Pusher; Harris Lodge, Homco Salesman.

OIL PRODUCTION MAINTENANCE, INC.
1440 CHOCOLATE BAYOU ROAD — P. O. BOX 14291
HOUSTON 21, TEXAS

September 13, 1956

Mr. Gordon P. Street, President
The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

Oil Production Maintenance, Inc. owns and operates two Wheland power pumps. One is a HP-14000 Wheland and the other is a HP-18000. Both of these pumps have been in operation approximately twelve months. We have experienced no difficulty either with the power end or the fluid end of either of these pumps over this period of time. Both of these pumps have been operated within approximately ten per cent of their rated capacities for the full twelve months.

During the twelve months period, the rig which operates the HP-18000 Wheland has drilled seven wells. They have varied in depth from 10,500 feet to 15,000 feet. The total footage accumulated by this rig during this time has been approximately 79,500 feet. We hope, and have every reason for our belief, that the pumps will continue their efficient operation for several years to come.

Yours very truly,

OIL PRODUCTION MAINTENANCE, INC.

J. K. Butler

J. K. Butler, President.

JKB:ml

OWNS 2 WHELAND PUMPS here's the report!

DEPENDABLE OPERATION!

". . . every reason for our belief that the pumps will continue their efficient operation for several years to come."

HP-18000 7¾" x 18", 750 HP Nominal Input at 60 RPM. Discharge Pressure with 7¾" liner 1322 PSI; with 5½" liner, 2700 PSI.

HP-14000 7½" x 14", 350 HP Nominal Input at 60 RPM. Discharge Pressure with 7½" liner 838 PSI; with 5½" liner, 1627 PSI.

BULLETINS ON REQUEST

WHELAND ROTARY DRILLING MACHINERY

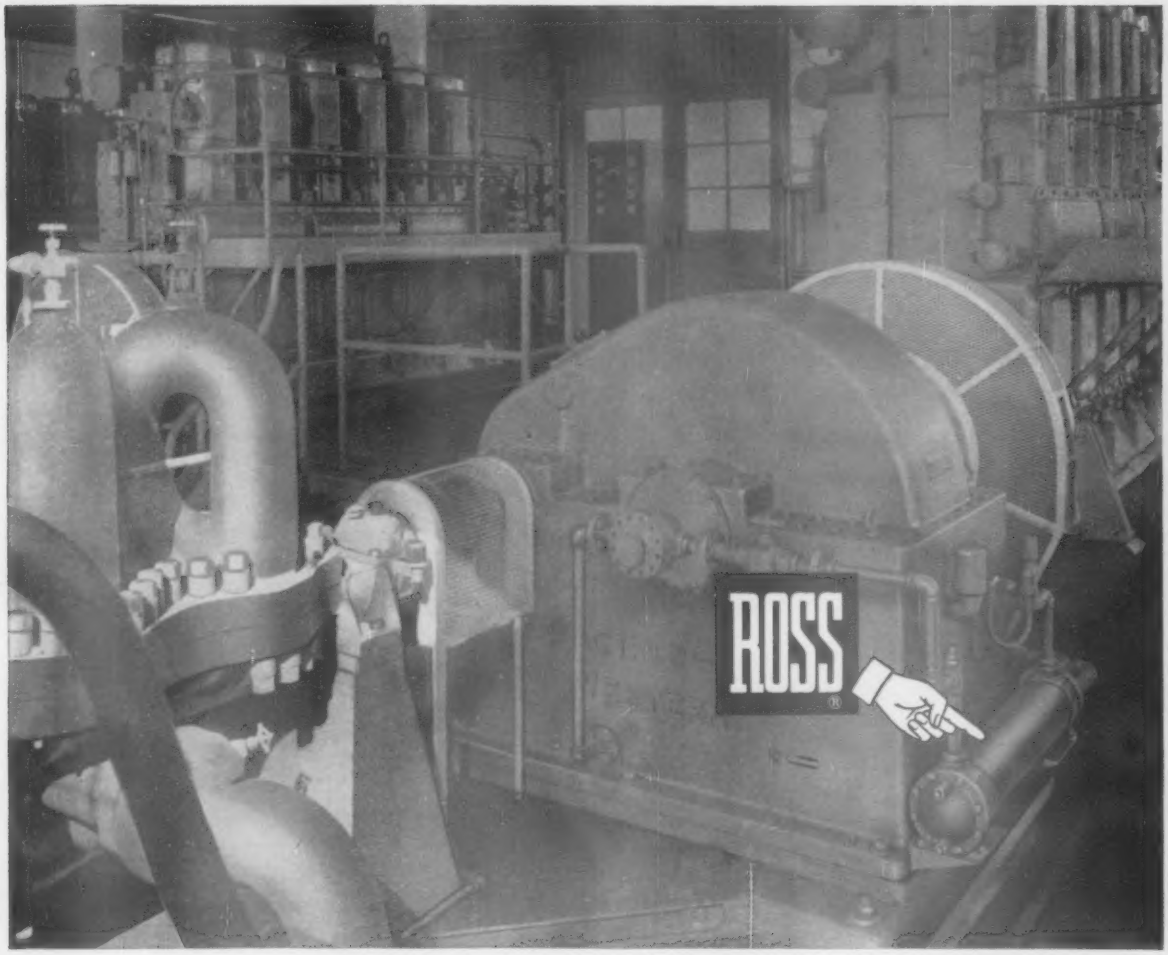
THE WHELAND COMPANY

CHATTANOOGA, TENNESSEE, U.S.A.

DRAW WORKS • SLUSH PUMPS • ROTARIES
CROWN BLOCKS • TRAVELING BLOCKS • SWIVELS

DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC.—Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC.—Main Office: Houston, Texas • JONES AND LAUGHLIN STEEL CORPORATION, SUPPLY DIVISION—Main Office: Drawer 2481, Tulsa 2, Oklahoma.

EXPORT DISTRIBUTORS: LUCEY EXPORT CORPORATION—233 Broadway, New York 7, New York—Broad Street House, London, E. C. 2, England.



*Trouble-Free ROSS EXCHANGERS

protect Western Gear Units along 65-mile pipeline

A recently completed 65-mile California pipeline linking the Santa Paula-Ventura fields to Wilmington now carries crude petroleum formerly transported by coastal tankers. Pictured above is the Western Gear Speed Increaser at the Ventura station, one of four units along the route.

For continuous temperature safety of gears and bearings, all four Western Gear units are equipped with Ross Type BCF Exchangers. Heat generated by power transmission is effectively carried away, and ample supplies of properly cooled lube oil are provided to vital moving parts at all times.

*Says Western Gear Corp., "We have never had any trouble with Ross Exchangers over a period of many years. They adapt themselves ideally to our gear boxes, and your company provides excellent engineering assistance in determining the correct exchanger for the job to be done."

Repeatedly chosen for their rugged dependability as well as their high thermal efficiency, Ross Exchangers are used extensively throughout the oil and gas industry to meet heat transfer requirements for lube oil, jacket water, air and hydraulic fluid.

Easy to install, these compact units are pre-engineered and fully standardized in a broad range of sizes. For detailed information, request Bulletin 1.1K5. Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

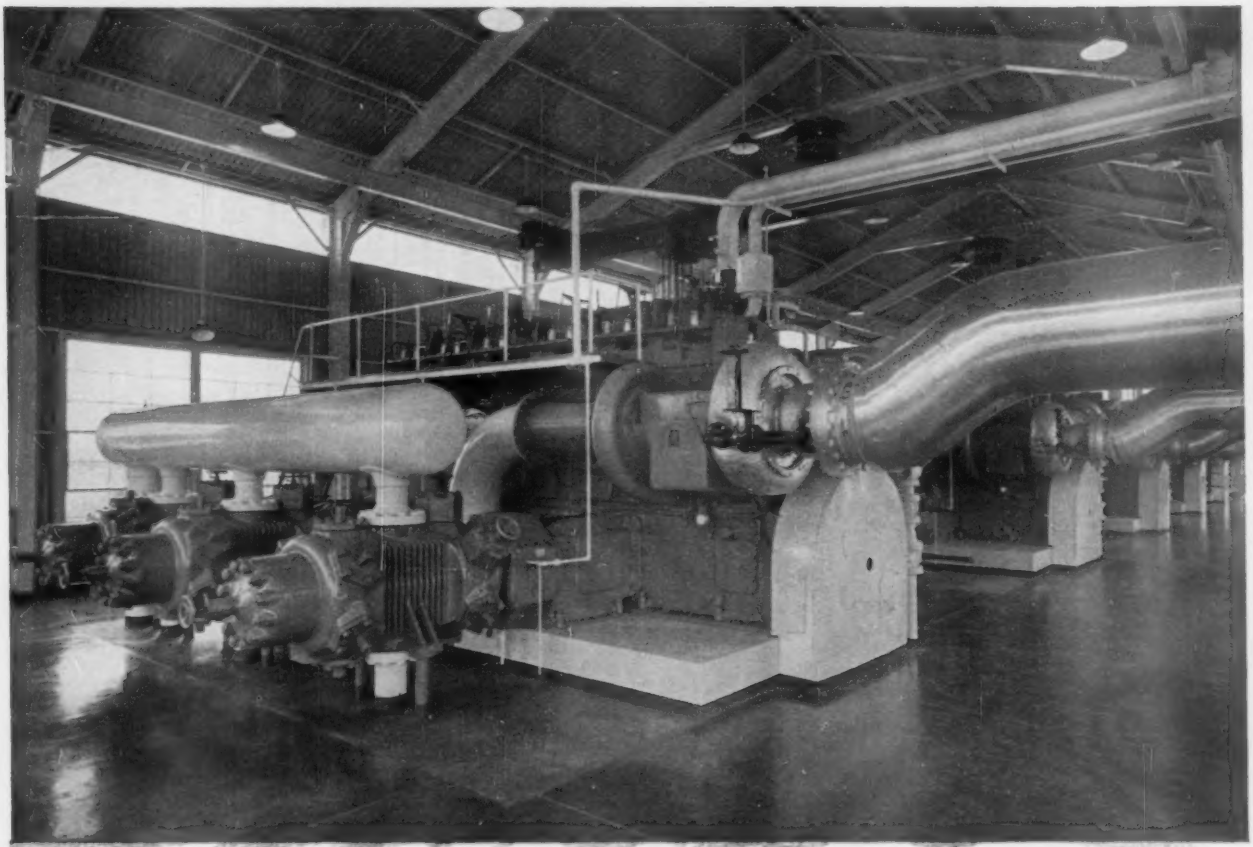
ROSS HEAT EXCHANGER

Division of AMERICAN-Standard

For Pacific Northwest's...

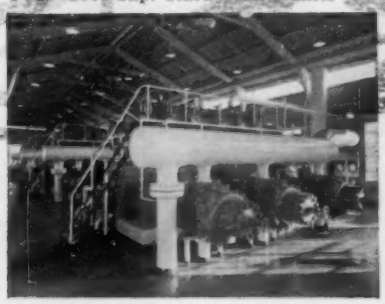
Altitude: 6600'

Station-1. Ignacio, Colorado
Six–2000 bhp. Clark TLA-6 Turbo-supercharged Compressors



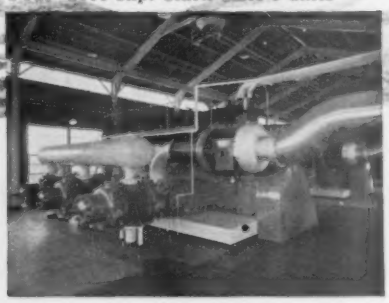
Altitude: 5620'

Station-2. Moab, Utah
Four–2000 bhp. Clark TLA-6 units



Altitude: 6000'

Station-4. Rangely, Colorado
Four–2000 bhp. Clark TLA-6 units



Mile high pipeline

46,000 BHP. of Clark Turbo-supercharged Compressors Furnish Over Half the Main Line Horsepower

Some of the most rugged terrain in the country is covered by Pacific Northwest's 1500 mile pipeline serving the northwestern part of the United States. Twenty-three Clark 2000 bhp. TLA-6 turbo-supercharged compressors supplied over half of the main line horsepower.

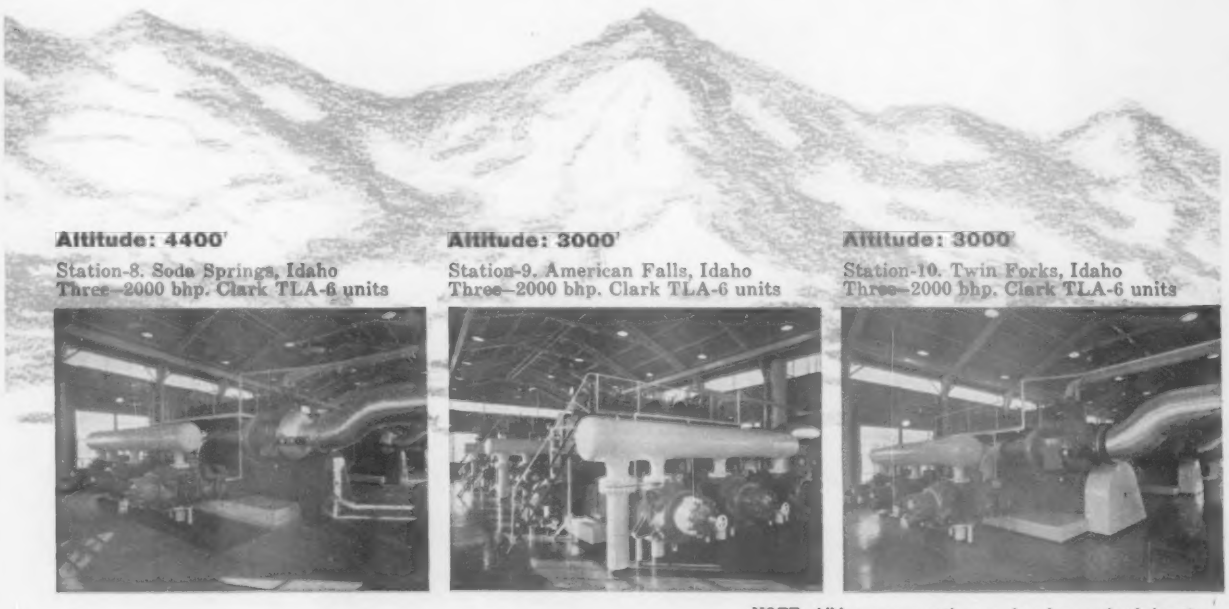
With stations operating at elevations of up to 6600′, normally aspirated engines would have required heavy deration. The Clark TLA-6 units, however, operate with substantially less deration because they are turbo-supercharged. (Clark can now supply for its TLA units, as optional equipment, a special turbocharger for high altitude applications which permits sea level ratings. No deration is required.)

Mountain top locations or "down in the flats", the modern Clark turbo-supercharged compressor is the most economical prime mover to install on today's pipelines. They are built in seven sizes ranging from 1100 to 3400 bhp. Your nearest Clark representative will be pleased to give you complete information.

CLARK BROS. CO., OLEAN, NEW YORK
One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK®

Turbo-supercharged Compressors



Altitude: 4400′
Station-8. Soda Springs, Idaho
Three–2000 bhp. Clark TLA-6 units

Altitude: 3000′
Station-9. American Falls, Idaho
Three–2000 bhp. Clark TLA-6 units

Altitude: 3000′
Station-10. Twin Forks, Idaho
Three–2000 bhp. Clark TLA-6 units

NOTE: All horsepower ratings are based on sea level elevation.

American Louisiana Pipeline carrying natural gas 1000 miles from Louisiana to Michigan, was given the proven protection of coal-tar enamel coatings. Three different types of enamels were used on various sections: Bitumastic® No. 2 Enamel for application in mild climates, Bitumastic No. 70-B Enamel for application to portions subjected to colder weather, and Bitumastic Hi-Melt Enamel for hot sections of the line after compressor stations. There's a Bitumastic Enamel for every pipeline need, from hot-line coating to sub-zero conditions. Your Koppers representative will be glad to explain why coal-tar enamel is your best investment for long-lasting protection of underground pipelines.

Metal Buildings have longer useful life when they are protected against corrosion by Bitumastic coatings. This oil company warehouse was completely cleaned, then coated with a system using Bituplastic® No. 28, a sunlight-resistant coal-tar coating. Added life of the structure through this treatment is estimated at 10 years.

This New Bulletin outlining the useful scope of Bitumastic cold-applied protective coatings is now available. You'll find it a handy guide in the selection of corrosion-resistant coatings for your applications. For your copy, write: Koppers Company, Inc., Tar Products Div., 1450 Koppers Bldg., Dept. 104C, Pittsburgh 19, Pa.

how to
CUT CORROSION LOSSES
a report by Koppers Company, Inc.

Number 9 of a series

W. E. Kemp
Manager, Technical Department

One problem in the protective coating of steel structures is that of *interim protection* between fabrication and erection. In some cases this is a relatively short time; in others, as much as two or three years. Here is a typical question put to us recently by an engineering firm purchasing fabricated steel penstocks for shipment and erection overseas. Since penstocks are constantly exposed to water, coal-tar enamel coating is usually applied after erection.

* * *

"On jobs where the sandblasting of surfaces to bright metal prior to priming and coating is mandatory and the time between fabrication and erection is 3 months to 1 year, should we (1) shop-prime only before shipment or, (2) ship uncoated or, (3) sandblast and prime in the shop, then ship and clean (not sandblast) and prime as necessary in the field?"

The inquirer went on to ask what we would recommend if the interim period was *more* than one year or more than *two* years. Obviously, it's difficult to answer questions like this without knowing specific field conditions. However, here are our general recommendations on the protection of steel between fabrication and field enameling.

If specific job conditions specify that sandblasting be done in the field, the best practice would be to ship the steel *uncoated*, provided that it will not be exposed for more than one year to atmospheric corrosion. Actually, the rusting which will occur on the unprotected surfaces will serve to destroy mill scale which should *always* be removed prior to coating. In our experience, shop-priming without sandblasting prior to shipment almost always gives difficulty in the field.

If the steel is to be installed during a period of three months to one year after it leaves the shop and there is a choice as to where the sandblasting will be done, we still recommend the above procedure. Less satisfactory, but the best alternate, would be to sandblast and shop-prime before shipment; then wire brush, prime and enamel in the field.

If the steel will not be enameled or coated for more than two years after fabrication, a detailed examination of the corrosive atmosphere in which the steel will be stored must dictate the coating procedure.

* * *

Another important point in corrosion prevention on fabricated metal is the physical handling necessary for shipment, storage and erection of the structures. If excessive handling is anticipated, it has been our experience that it is more economical and efficient to field coat. Shop coating may be scratched and chipped to a point where it becomes very time-consuming and costly to "touch-up" the structure after erection.

* * *

If you have any questions about corrosion control or specific problems, write: Koppers Company, Inc., 1450 Koppers Building, Department 104C, Pittsburgh 19, Pa. District Offices: Boston, Chicago, Los Angeles, New York, Pittsburgh and Woodward, Ala. In Canada: Koppers Products, Ltd., Toronto, Ontario, and Edmonton, Alberta.

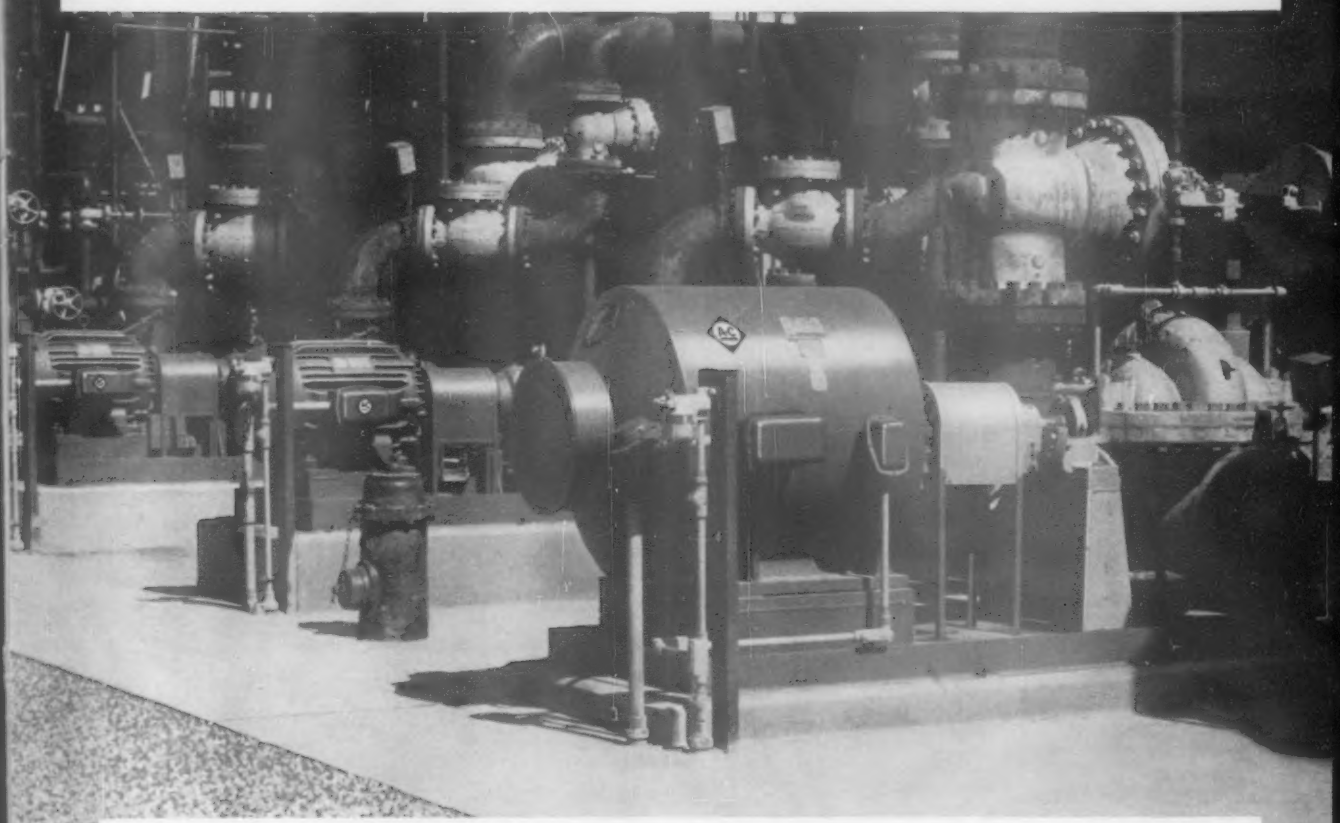
KOPPERS

BITUMASTIC
REG. U. S. PAT. OFF.
COATINGS AND ENAMELS

for more continuous processing—

Another great refinery installs

ALLIS-CHALMERS MOTORS



Thousands of horsepower in Allis-Chalmers motors will drive processing equipment at Tidewater Oil Company's new Flying A Refinery, near Delaware City, Delaware.

Designed and constructed by C. F. Braun & Co., engineers and constructors, this plant will process 130,000 bbl of crude oil per day. The largest ever built in a single construction operation, this huge refinery joins a growing list of major petroleum plants in which Allis-Chalmers equipment is used. Main reason for this trend:

Continuous Operation

● **Ribbed Construction** of smaller motors gives up to 43% more cooling surface when compared with ordinary motors. *Tube-Cooled* design in larger sizes permits free flow of air. BOTH designs result in fewer winding burnouts.

● **Motors** are of the chemical type, designed for use in refinery operations.

● **Stators** receive more than the usual dips and bakes. They get extra dips and bakes plus two coatings of red enamel to provide maximum electrical life.

* * *

FIND OUT MORE about Allis-Chalmers motors for the petroleum industry. Contact your nearby A-C sales office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

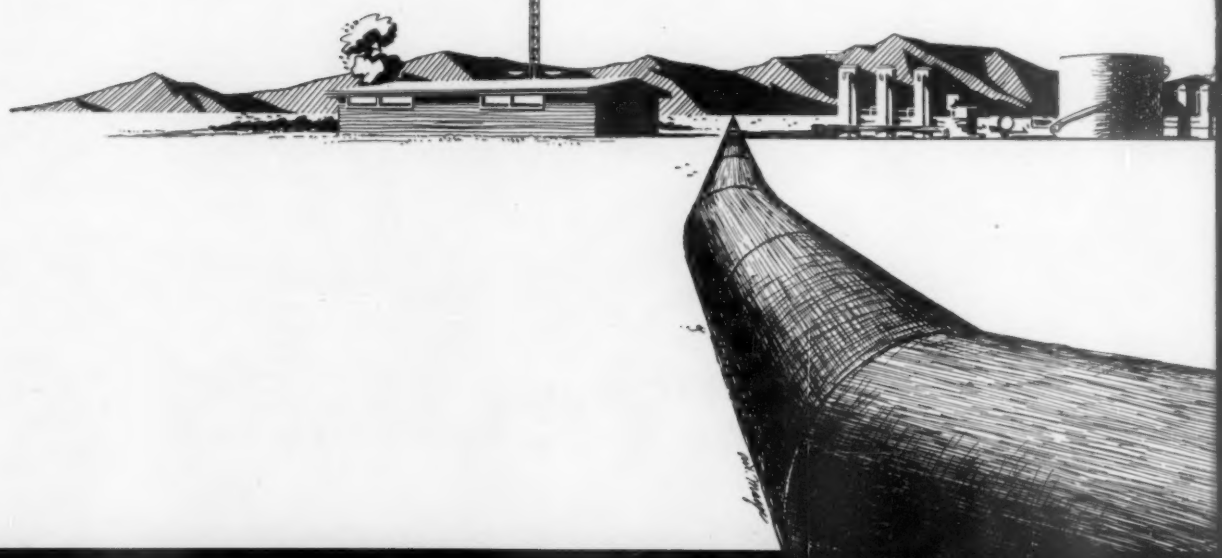
A-5185

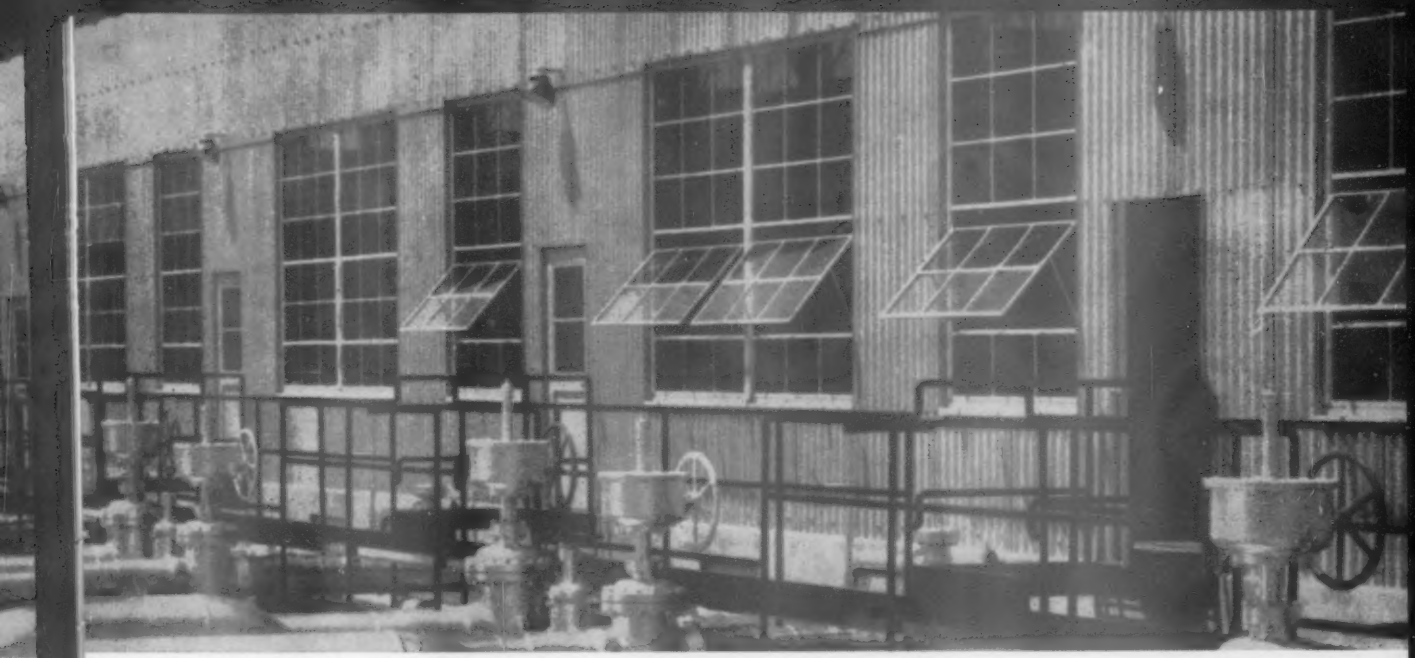
For forward thinking pipeliners

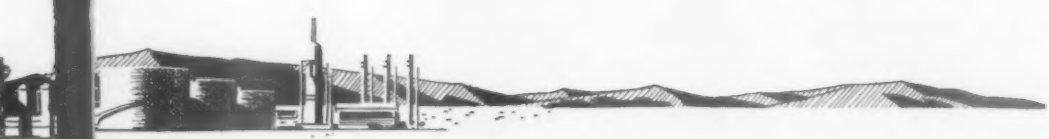
COLLINS MICROWAVE...

Collins is uniquely qualified to engineer your complete "turn-key" microwave system — consultant service, planning, siting, equipment, installation, training and field service.

Let Collins provide your own private communication and control system, tailored to your individual requirements. Your microwave system design will be flexible, readily adaptable to tomorrow's expansion.

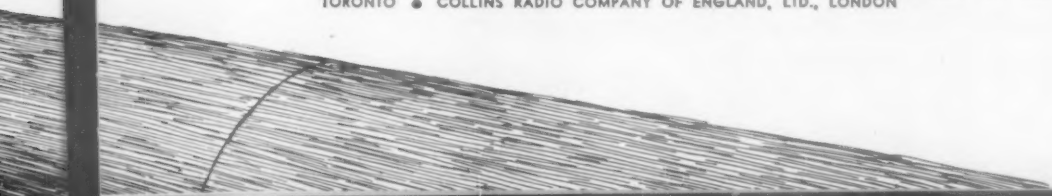






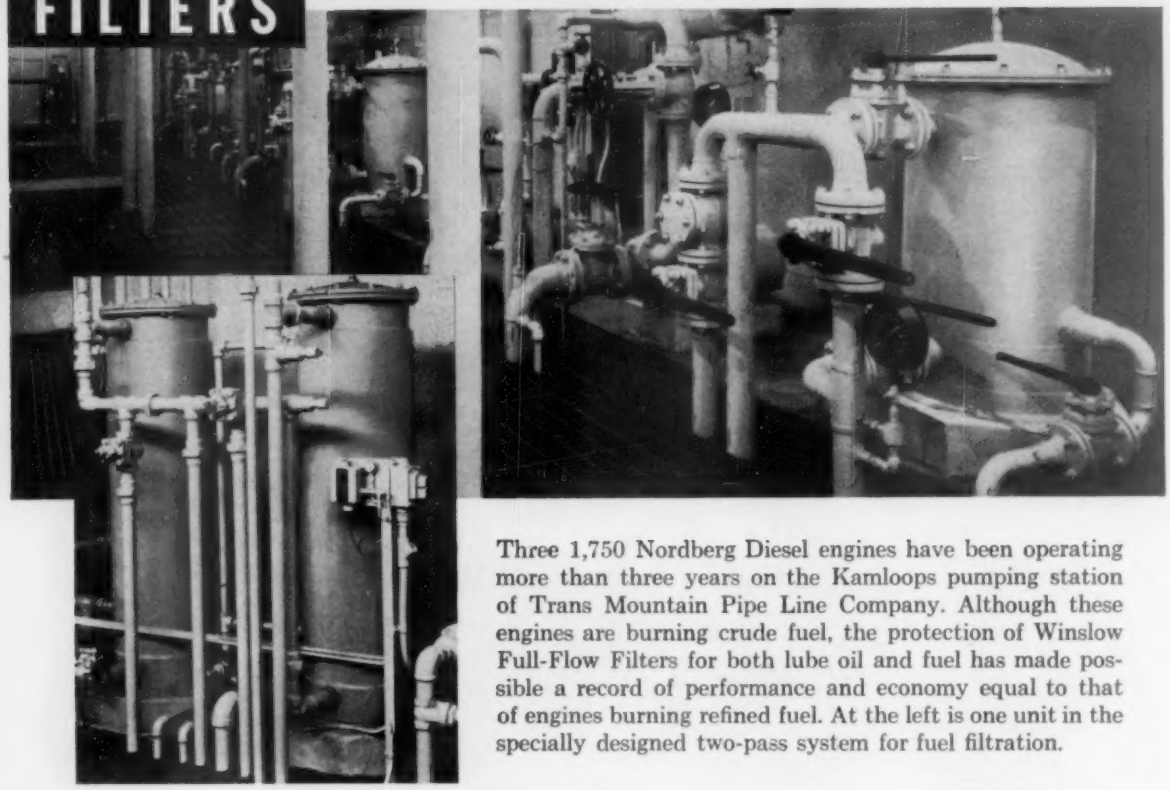
Collins **CREATIVE LEADER IN COMMUNICATION**

COLLINS RADIO COMPANY, DALLAS • CEDAR RAPIDS, IOWA • BURBANK • NEW YORK
WASHINGTON, D.C. • MIAMI • SEATTLE • COLLINS RADIO COMPANY OF CANADA, LTD.,
TORONTO • COLLINS RADIO COMPANY OF ENGLAND, LTD., LONDON



WINSLOW *Full-Flow* FILTERS

Case History Report No. 34 Shows Why Engines Protected by WINSLOW FILTERS Last Longer



Three 1,750 Nordberg Diesel engines have been operating more than three years on the Kamloops pumping station of Trans Mountain Pipe Line Company. Although these engines are burning crude fuel, the protection of Winslow Full-Flow Filters for both lube oil and fuel has made possible a record of performance and economy equal to that of engines burning refined fuel. At the left is one unit in the specially designed two-pass system for fuel filtration.

20,000 HOURS OPERATION—Parts Replaced ONLY $300

CP* FILTRATION

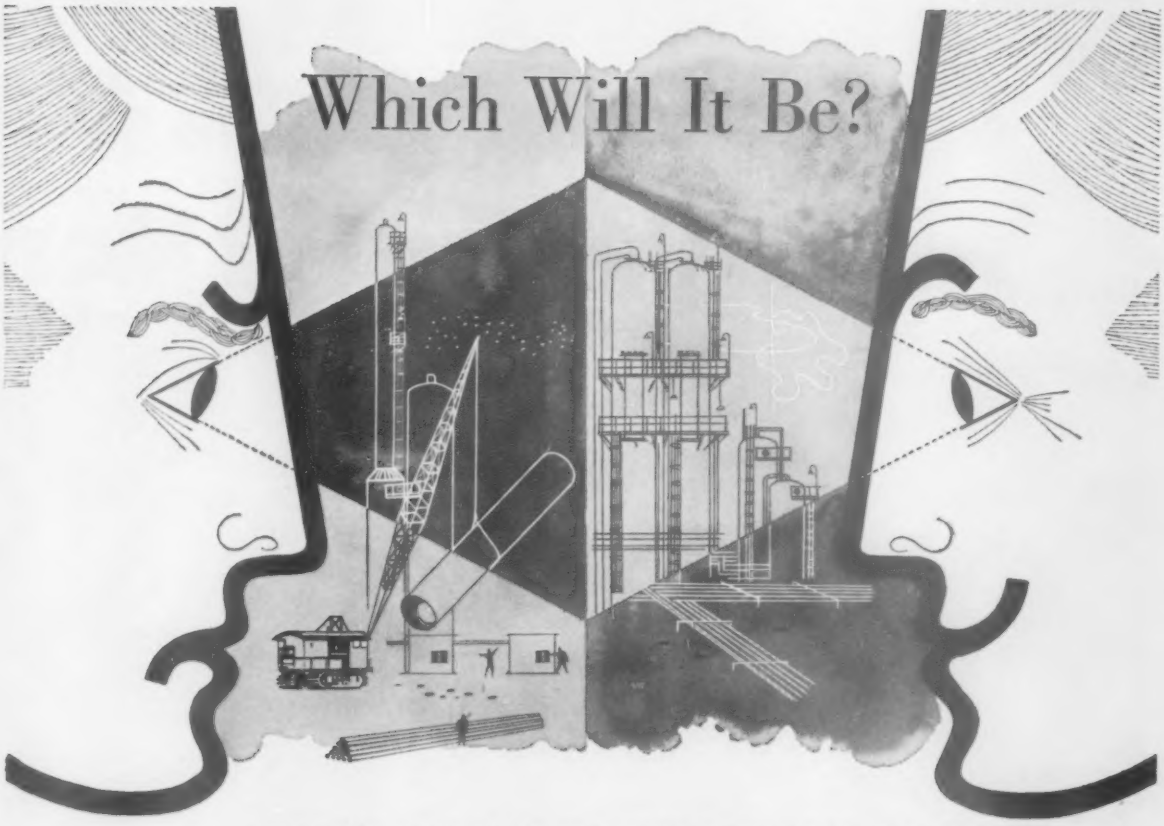
Winslow patented CP* (Controlled Pressure) elements are designed to continuously self-adjust the pressure within the filter and allow for a full stream of filtered oil without opening by-pass valves. This is accomplished through the dual flow capacity, with two types of material.

After 20,000 hours operation in a three-year period, the first Nordberg Diesel in a Trans Mountain Pipe Line station was recently overhauled. In spite of the use of crude fuel, and difficult operating conditions, the engine was in such good condition that only $300 worth of replacement parts was required. This is another striking example of the long engine life and the substantial savings in overhaul time and replacement costs when dirt, acid, moisture and other impurities are removed by Winslow Filters. Standard or special installations of Winslow Full-Flow Filters can give you equal engine economies. Please write for complete information.

CP is fully protected by patents and trademarks*

WINSLOW ENGINEERING & MANUFACTURING COMPANY

4069 Hollis Street, Oakland, California



COSTLY DELAYS OR ON STREAM ON TIME?
PRITCHARD'S SINGLE RESPONSIBILITY CONTRACT
CAN MAKE THE DIFFERENCE!

When you build a new plant... modernize or expand your present facilities... a Pritchard Single Responsibility Contract can make a lot of difference.

It's different because... you sign just one contract, with one firm, for everything! Everything from the designing right through the engineering, purchasing, construction, and final testing of your new plant.

You save time and money because the right hand always knows what the left hand is doing! Construction actually begins before the engineering drawings are completed. Pritchard teamwork makes this possible. Years of experience and careful coordination make each step dovetail together in less time... and at less cost to you.

And here's the big difference! Since your building project is completed on time, your investment starts paying a return much faster and your invested capital is freed sooner for other uses.

On top of these important benefits, you get unmatched engineering service carefully coordinated under one single responsibility—a prerequisite of any successful project.

Let Pritchard make the difference for you!

YOUR INQUIRY IS INVITED

SERVING THE GAS, PETROLEUM, CHEMICAL, PETROCHEMICAL, PULP, AND PAPER INDUSTRIES AND THE POWER PLANT NEEDS OF INDUSTRY AND CORPORATE UTILITIES.

INDUSTRY'S PARTNER FOR PROGRESS

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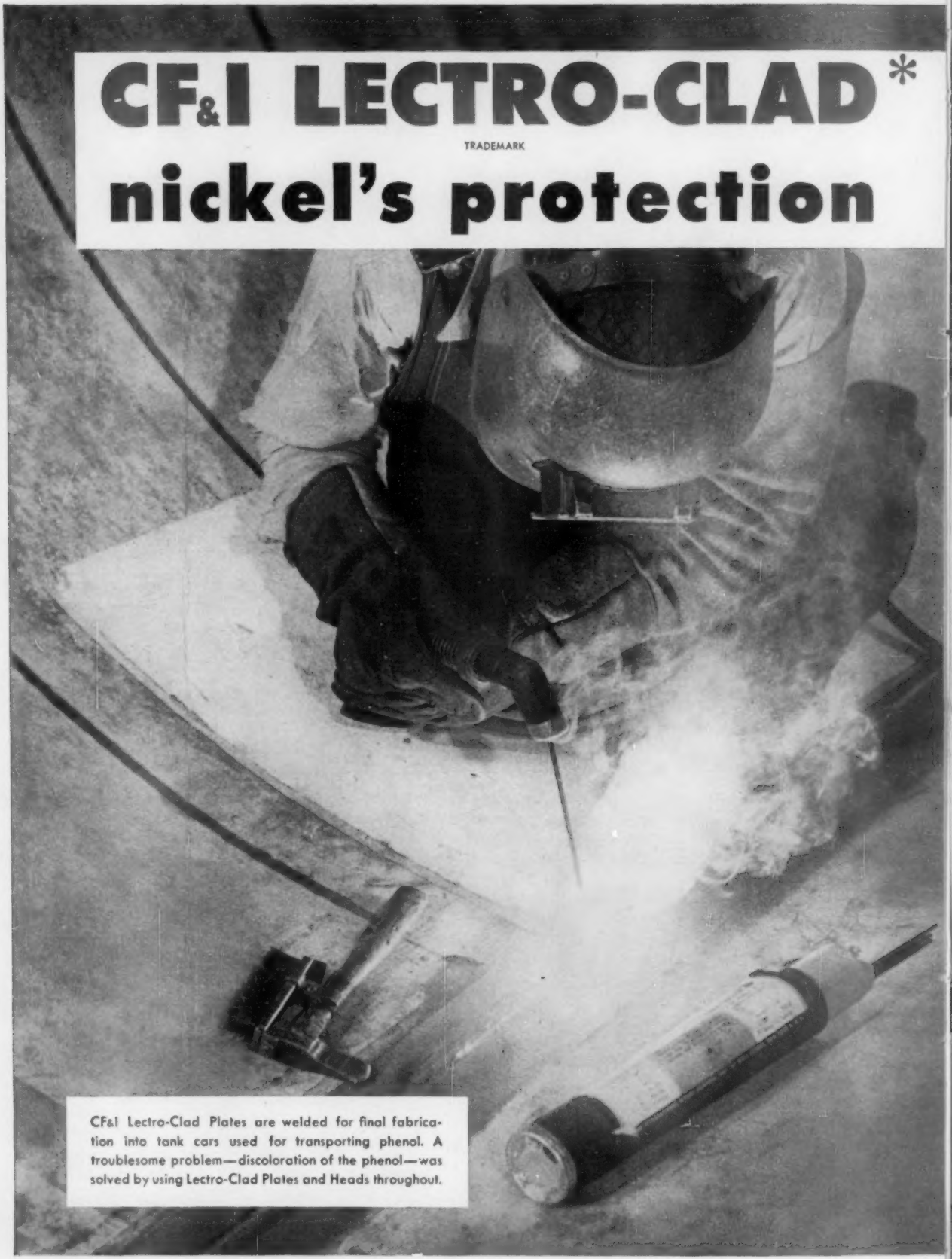
MANUFACTURERS
OF COOLING TOWERS AND GAS AND AIR TREATING EQUIPMENT

CF&I LECTRO-CLAD*

TRADEMARK

nickel's protection



CF&I Lectro-Clad Plates are welded for final fabrication into tank cars used for transporting phenol. A troublesome problem—discoloration of the phenol—was solved by using Lectro-Clad Plates and Heads throughout.

PLATES offer you... *plus* 6-8 week availability

Stop waiting months for delivery on nickel and nickel-clad plates! Switch to CF&I Lectro-Clad Nickel Plated Steel. Smart fabricators and end-users all over America are finding that this dependable product successfully combines the protection of nickel and the economy and strength of carbon steel. AND CF&I LECTRO-CLAD NICKEL PLATED STEEL PLATES ARE AVAILABLE WITHIN 6 TO 8 WEEKS!

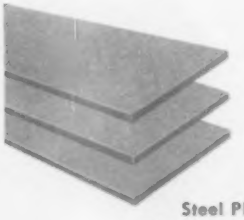
CF&I Lectro-Clad Plates and Heads are now being used successfully in many transportation and storage applications where product contamination or discoloration is a problem. They are also effective for processing applications where the corrosion rate does not exceed .0015 inches per year. CF&I Lectro-Clad is customarily supplied with 8-10 mil nickel plating; however, it can be plated up to 28-30 mils if specified.

CF&I Lectro-Clad is easy to fabricate. It can be worked with regular shop equipment. Bend it . . . weld it . . . roll it . . . the protective nickel layer stays firmly bonded to the steel. It will not check, spall or flake.

Delivery time on this 8-foot diameter caustic evaporator was reduced by one full year when its fabricator switched to CF&I Lectro-Clad. Plate used was 3/8" steel with a 15 mil layer of nickel. Heads were also fabricated from Lectro-Clad.

For the complete story on Lectro-Clad, ask for the Lectro-Clad Nickel Plated Steel Technical Manual. Contact our nearest sales office or write us direct. Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation, P. O. Box 1951, Wilmington, Delaware.

OTHER CLAYMONT PRODUCTS



Steel Plates
Alloy · Stainless Clad
High Strength Low Alloy

Fabricated Steel Parts

Flanged and Dished Heads
Manhole Fittings and Covers

Large Diameter Welded Steel Pipe

CF&I

Claymont Steel Products

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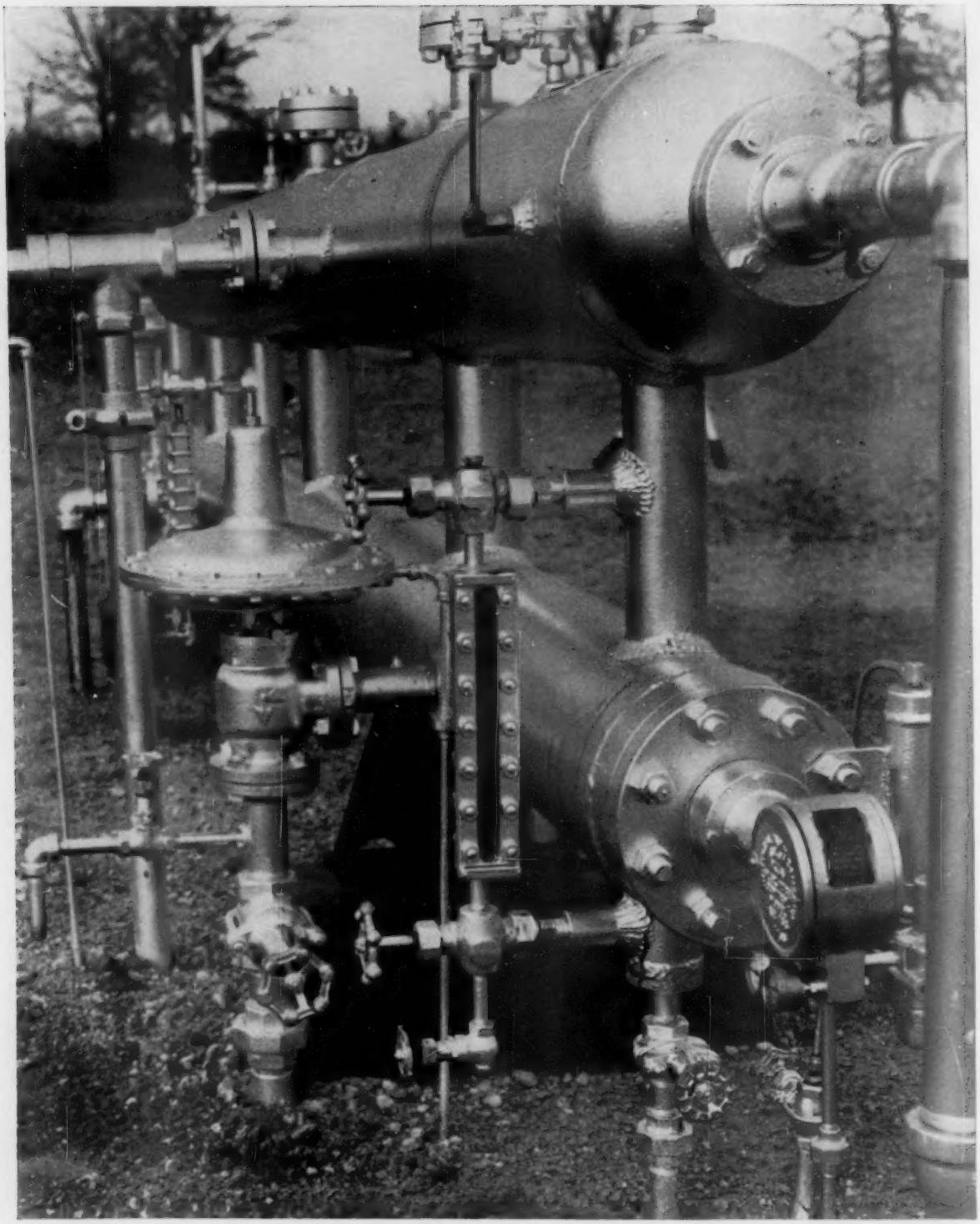
Seattle · Spokane · Tulsa · Wichita · CF&I OFFICES IN CANADA: Montreal · Toronto · CANADIAN REPRESENTATIVES AT: Calgary · Edmonton · Vancouver · Winnipeg

***NICKEL PLATED BY THE BART LECTRO-CLAD PROCESS**

4338



● **PENBERTHY GAGES** on two stage separator,
The Superior Oil Company Lease, Zablaudil

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- EJECTORS
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Polyken Tape Coating Method again proves itself in rugged going

Versatile, easy-to-apply polyethylene tape by Polyken protects mountainous pipeline

Again, Polyken tape coating proved itself where the going got rough.

The problem was to protect a pipeline running through the rugged, coal bloom terrain between Kentucky Hydrocarbon at Maytown, Kentucky, and the Union Carbide and Carbon plant at Institute, West Virginia—100 mountainous miles with up to 60° slopes.

Here, the Polyken tape coating method, because of its tremendously simplified application, proved the answer, and the pipeline went through on schedule.

Using coatings that have to be prepared at the site would have been extremely difficult, if at all possible, in this type of country.

Learn more about Polyken protective coatings. Write, wire or phone *Polyken Sales Division*, 309 W. Jackson Blvd., Chicago 6, Ill. WEbster 9-7100.

In the roughest spots, this manual wrapping machine can apply Polyken tape and a protective outerwrap—all at the same time.

THE SEVEN COST-CUTTING ADVANTAGES OF POLYETHYLENE TAPE COATINGS BY POLYKEN
(the original polyethylene tape)

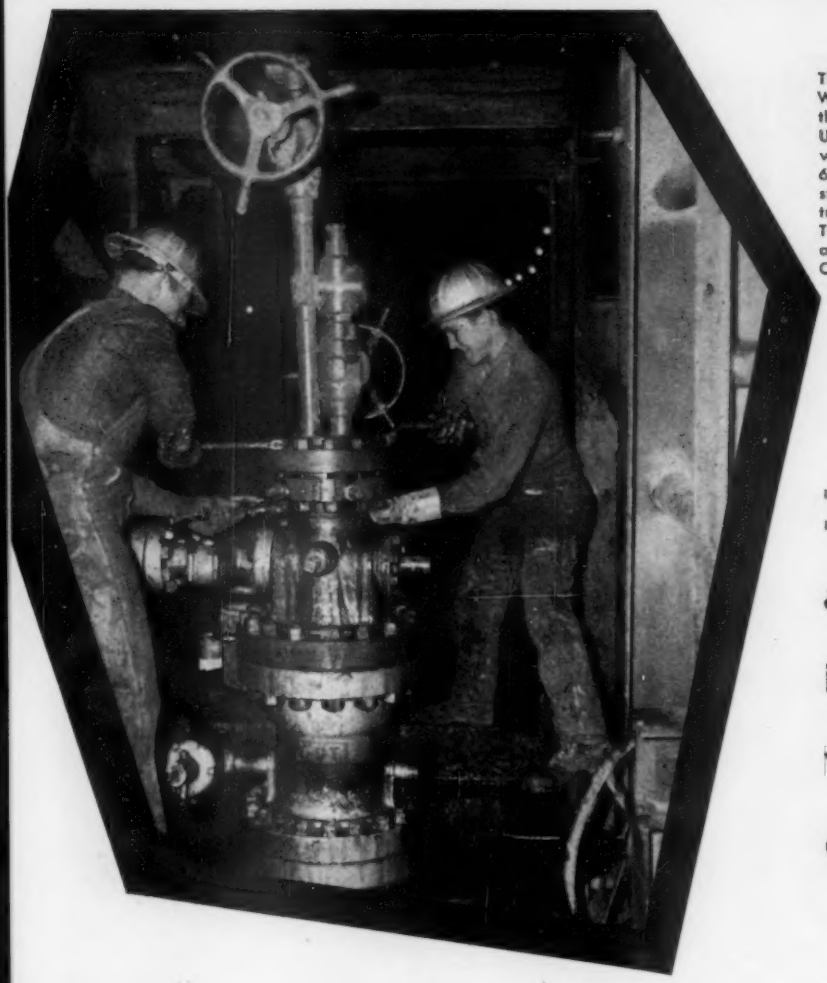
1. Tremendous labor and equipment savings because of simplified operation.
2. Faster coating—consistent high daily output.
3. No hot dope preparation—tape is ever ready.
4. No cooling or drying time.
5. Vastly reduced warehousing, shipping, handling costs.
6. No hot dope liabilities—no fumes, no burns, no livestock losses.
7. Wrap goes into ground in factory-uniform condition.

Complete catalog, Sweet's Industrial Construction File, Sec. 3J/K•

Polyken®

PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division



This O-C-T Dual String Wellhead Assembly has the new O-C-T Universal Tubing Head which accommodates 6 interchangeable dual string and single string tubing hangers. The foundation is an O-C-T "C-19" Casing Head.

FIRST

and still first... in high pressure wellhead equipment

This O-C-T Dual Completion Tree is only one of many economically important products pioneered by Oil Center Tool Company. It is the result of more than 15 years of continuous improvement in multiple zone completions.

Other O-C-T "Firsts:" the FIRST factory-assembled and tested Christmas Tree . . . the FIRST 10,000, the FIRST 15,000, the FIRST 30,000 pound test Christmas Trees . . . the FIRST casing head with an automatic seal . . . the FIRST and only flow control that gives advantages of both a choke and a valve . . . the FIRST universal tubing head.

When you are ready to complete your next well, turn first to the organization that was first . . . and still first . . . in meeting your present and future needs for dependable high pressure wellhead equipment. You'll be money ahead!

O·C·T

OIL CENTER TOOL CO.
HOUSTON

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

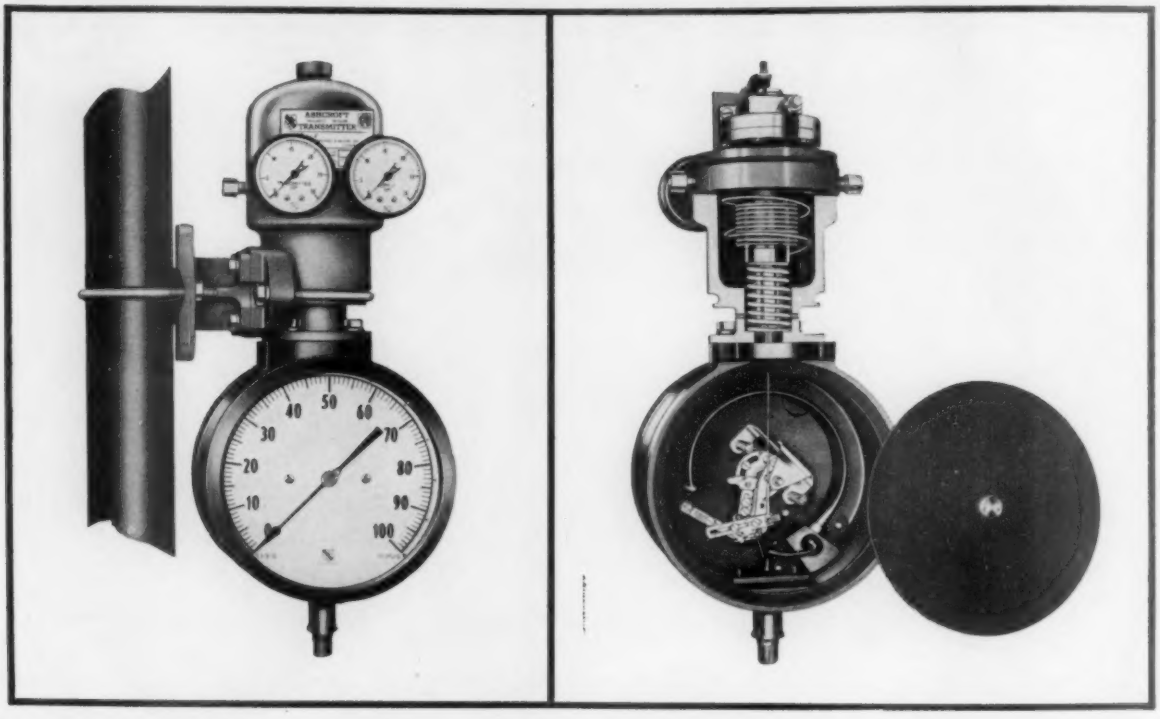
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.

Designed to solve safety and service problems

...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6" indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to 100,000 psi with complete safety for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

DODGE *PowerGiants*

Dodge T700
Tandem

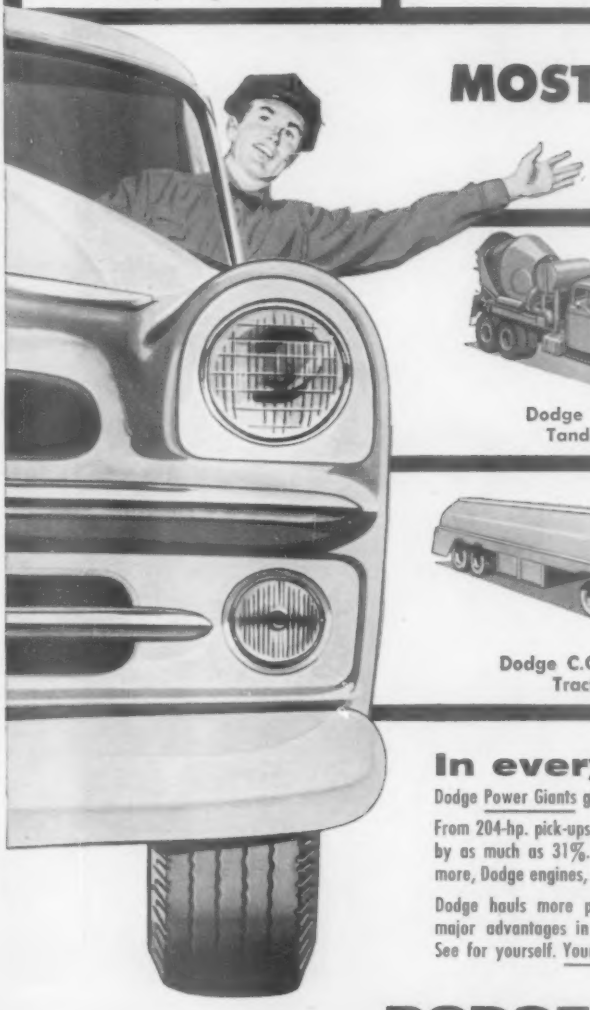
Dodge P300
Forward-Control

Dodge 600
with Van Body

Special bodies fit readily
on any Dodge chassis

Dodge 500
Stake

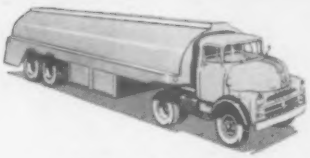
Dodge 400
with Beverage Body



MOST *POWER* OF THE LOW-PRICED 3

Dodge T900
Tandem

Dodge 100
Panel



Dodge C.O.E. 700
Tractor

Dodge 800
Tractor

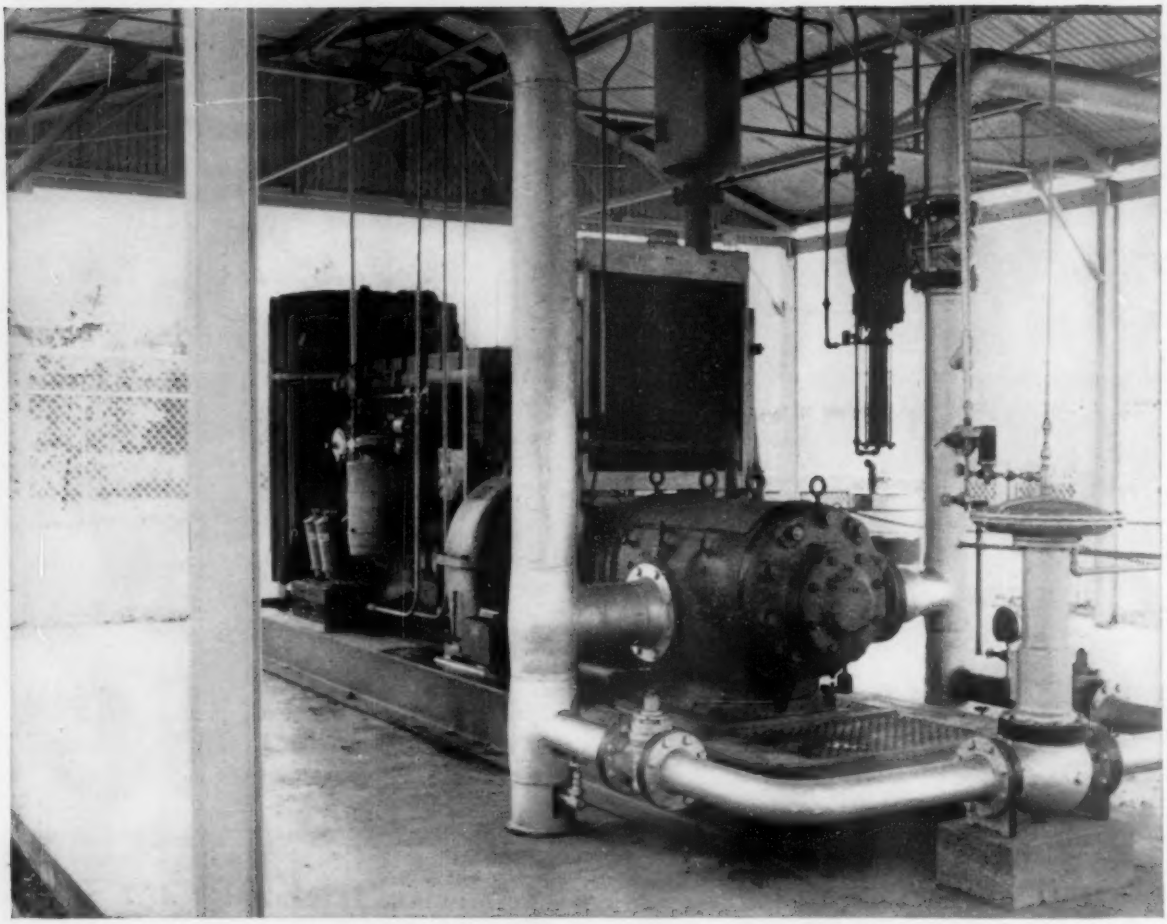
In every weight class

Dodge Power Giants give you an extra bonus of power.

From 204-hp. pick-ups to 232-hp. tandems, Dodge V-8's outpower the "other two" by as much as 31%. This extra power reduces engine strain, saves wear. What's more, Dodge engines, both V-8's and 6's deliver full power on regular gas.

Dodge hauls more payload, too . . . up to one-third more. And Dodge offers major advantages in driving ease, cab comfort and prestige-building good looks. See for yourself. Your Dodge dealer has a Power Giant to meet every trucking need.

DODGE TRUCKS WITH THE *FORWARD* LOOK



TO START COMPRESSOR: PUSH BUTTON, EVEN MILES AWAY

Gas installations using Fuller Rotary Compressors have the advantage of remote-control operation, with the assurance of continuous peak performance under all weather conditions. Day and night operation under peak loads is possible with minimum supervision and maintenance. In the installation illustrated above, used for pumping from a gasholder into gas mains, the unit can be started and stopped at the unit or at a remote-control station approximately six miles away.

Fuller Rotaries feature simplified design, with rugged construction. They are compact and economical in operation. Valves, crankshafts, pistons and many other moving parts are eliminated, assuring smooth operation.

Oil and gas men concerned with gas gathering, gas boosting, and refinery in-plant service, as well as special compressor operations, rate Fuller Rotaries tops in performance.

C-308
3751

FULLER COMPANY
132 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
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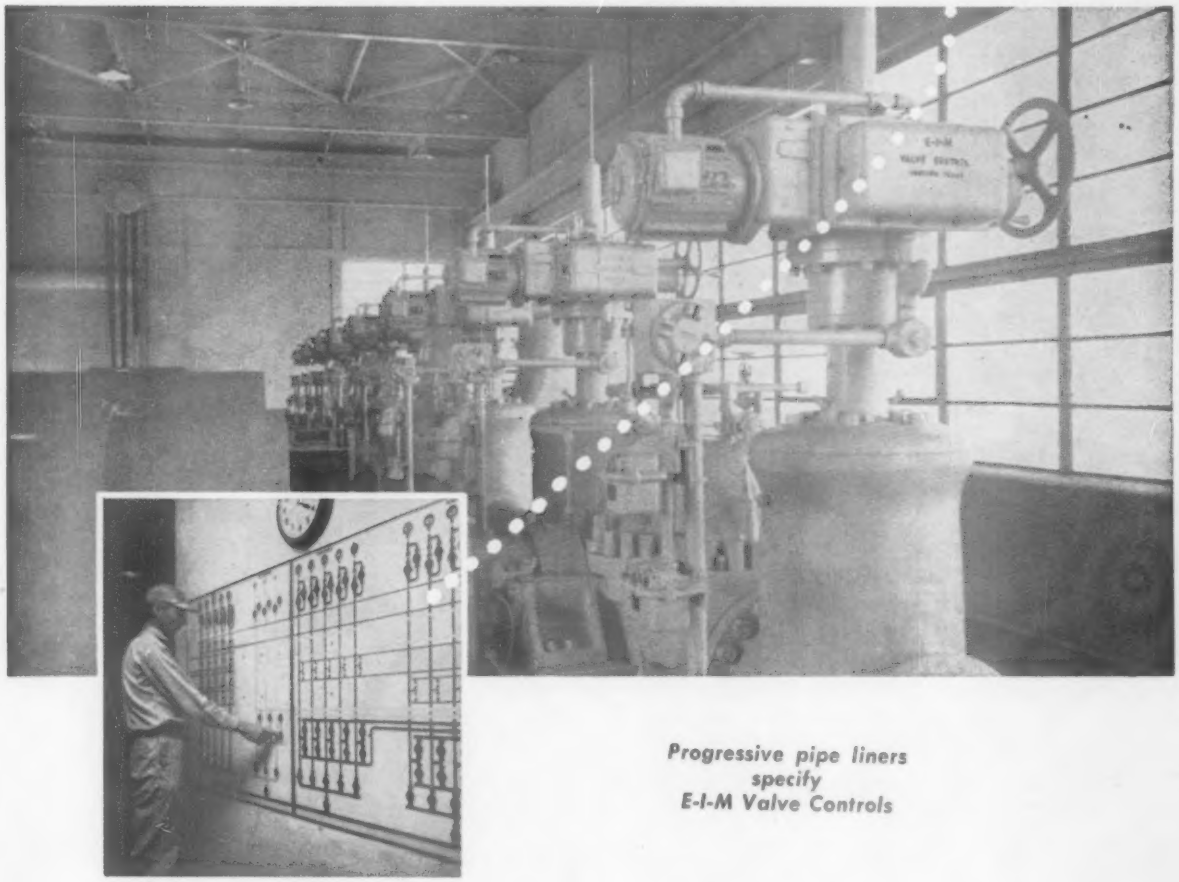
Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

EFFICIENT, INSTANTANEOUS MOVEMENT

West Texas Gulf Pipe Line Co., like many outstanding transmission lines, makes E-I-M Valve Controls the heart of the modern pumping station—striking a single push-button automatically opens the station block-valve and in sequence the pump suction-valve, pump motor, pump discharge-valve



Progressive pipe liners specify E-I-M Valve Controls

E-I-M Company INCORPORATED

1340 OLD SPANISH TRAIL ● HOUSTON 25, TEXAS ● MOhawk 4-4587

Valve Controls ● Speed Reducers ● Cooling Tower Drives ● Control Valves

LIGHT-WEIGHT PIPE

With the GUTS to Gather Gas

Just because Naylor Spiralweld pipe is light in weight, you don't have to baby it in gas-gathering service.

The same structure that gives Naylor its distinctive appearance makes it stronger and safer. The spiral lock acts as a continuous expansion joint to absorb shock loads, stresses and strains and gives the pipe greater collapse strength.

It's this combination of performance features that gives Naylor pipe the guts to handle any gathering assignment throughout the entire range of diameters from 4 to 30 inches.

Naylor Spiralweld is available with standard weight pipe ends for stronger field welds.

Write for Bulletin No. 507 or call our distributors.

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EXCLUSIVE DISTRIBUTORS IN MID-CONTINENT AND GULF COAST AREAS

MID-CONTINENT SUPPLY CO.
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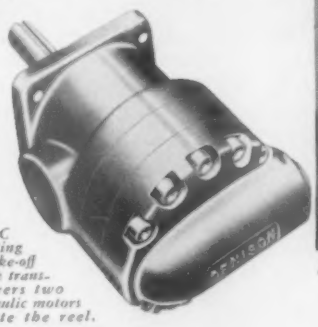
Hydraulic control panel, located immediately to right of driver's seat, permits pinpoint accuracy in controlling the wire line reel.



Denison TMC pump, operating on a power take-off from the truck transmission, powers two Denison hydraulic motors which operate the reel.

Interior of Camco wire line service truck illustrating wire line reel powered by Denison hydraulic equipment.

Camco Makes Jarring News

...hydraulically-powered service unit affords infinitely variable line speed

WITH THEIR truck-mounted, hydraulically-powered wire line unit, Camco, Inc., of Houston, Texas, has developed a means to speed and simplify oil well servicing.

Designed for removing production tools from a permanent-type well, it is easily adapted to perform surveys which determine a well's characteristics.

A Denison hydraulic pump, and two Denison hydraulic motors operate the 15,000 foot wire line reel. Seated at the control panel, the operator has infinitely variable line speed and can brake hydraulically going in or out of the hole.

The hydraulic control system makes it possible to reverse motors instantaneously while running at top speed, and permits "jar down" with a degree of controlled severity never before possible.

Hydraulic power is transmitted and applied without gears, transmission or other mechanical equipment, permitting accurate control. Better operation, savings in weight, and virtual elimination of maintenance are the benefits.

Let a Denison engineer show you how hydraulic power can improve your oil-field operations. Write to: Denison Engineering Division, American Brake Shoe Company, 1176 Dublin Road, Columbus 16, Ohio. Branch Offices at: 2501 Bartlett St., Houston 6, Texas, 4714 E. 22 Place, Tulsa, Oklahoma.

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON Hydraulics

Better, Stronger Piping Assemblies

through new Fluor cold-extruded prefabrication

Alloy steel header, with cold-extruded nozzles

Cold-extruded header, containing 45° miter weld

16-in. outlet nozzle, extruded in 30-in. diameter dampener head

Simple, more accurate fit-up... smoother nozzle contours... elimination of reinforcing pads assure important savings

WHEN YOU specify a multiple outlet header, cold-extruded by the new Fluor technique, you obtain a prefabricated piping assembly that offers higher strength, closer dimensional tolerance, smoother surface and greater uniformity.

Note these advantages Fluor-forming provides:

BETTER CONSTRUCTION: Fewer and simpler welds. More effective X-ray inspection.

LOWER MATERIAL COST: Elimination of reinforcing pads, saddles and collars makes savings in material costs substantial, especially where alloy steels are used.

SIMPLIFIED DESIGN: Nozzles or branches can be located anywhere along or around the header pipe.

SMOOTH NOZZLE CONTOURS: Minimizing pressure drop, reducing turbulence and erosion.

FASTER PRODUCTION: Less welding, less inspection make possible faster production and quicker delivery.

IMPROVED FIT-UP: Because of uniformly closer dimensional tolerances for each outlet nozzle, fit-up to adjoining piping is simple, accurate.

SAFETY: Uniform wall thickness, even distribution of mechanical stresses, avoidance of reinforcing pads and heavy welds assure protection against failure.

Write for Bulletin CE-0.001. EXTRUSION SALES, Fluor Products Company, Paola, Kansas.

A FLUOR-FORMED Product

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industry
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It takes STEEL to produce oil.

Steel fabricating plants, metal working shops, drill rig manufacturers, toolmakers and other Oklahoma plants make millions of dollars worth of oil field equipment for world-wide markets.

It takes a BANK'S cooperation, too. National Bank of Tulsa's Industrial Development Department provides prompt and confidential information so necessary to the planning, the establishment, the expansion, or the re-location of your company in Oklahoma's new industrial frontier.

Oil serves you every minute of every day. May we do the same in a financial way?

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hydraulic drives

PANHANDLE EASTERN PIPE LINE COMPANY

GARDNER-DENVER Since 1859

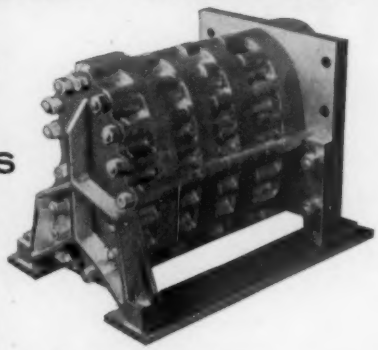
CITIES SERVICE

CLARK®

KANSAS-NEBRASKA NATURAL GAS COMPANY, INC.

COLUMBIA GAS SYSTEM — MANUFACTURERS LIGHT AND HEAT COMPANY

SOUTHERN CALIFORNIA GAS COMPANY



- *for power economy*
  Input horsepower varies with alternating requirements.
- *for safety*
  Hydraulic power completely safe in hazardous locations.
- *for less maintenance*
  All moving parts operate continuously in lubricating oil.
- *for flexible speed*
  Full power output at infinitely variable speeds.
- *for adaptability*
  Easily applied to toughest power transmission problems. Permits remote automatic control.

With reliability the first consideration in the oil and gas industry, it is not surprising that Berry Drives have gained wide acceptance by operators and equipment manufacturers alike. Berry Drives are synonomous with maximum economy and efficiency in drilling, producing and transmission of oil and gas.

Economical and easy to install . . . adaptable to practically every power transfer need, Berry Hydraulic Pump/Motor Drives assure smooth, sure, foolproof power at infinitely variable speeds. They are instantly reversible. They are quiet running with maximum power efficiency.

Send for this catalog now!
It's packed with simplified cutaways and data that tell you the "why" and "how" of Berry Hydraulic Drives.

B-5609

BERRY DIVISION

OLIVER IRON AND STEEL CORPORATION

PITTSBURGH 22, PA.

They Say—

Washington Post Views Oil Lift

"It now seems clear that much of the oil-lift controversy can best be read in terms of a continuing struggle between domestic and international oil companies. The domestics have long agitated for a reduction of oil imports, which now total about 1.5 million barrels a day. . . .

"... It had been thought that the emergency would require diversion to Europe of oil normally imported to this country. But it develops that there has been no appreciable slackening of imports to East Coast refineries. This result was achieved, apparently, by juggling tanker routes so that a surprising 40 per cent of Europe's overseas oil has been shipped from the Persian Gulf around Africa—twice the distance from Europe to the Gulf of Mexico.

"In other words, the import pattern apparently has been maintained throughout the emergency. Officials now say that it will be difficult to alter the market pattern once the emergency is over.

"In the midst of the emergency, news of a 'critical' crude-oil shortage emanated from London and was subsequently echoed by the American Government on January 27. At best, this news was an honest blunder and at worst a deliberate hoax.

"One immediate effect was to discredit domestic producers. This newspaper, along with others, chided Texas regulatory officials for unreasonably restraining production in face of a 'crisis.' Whatever the cause of the error, the resulting uproar could not have displeased the international companies who are locked in battle with the domestic producers."

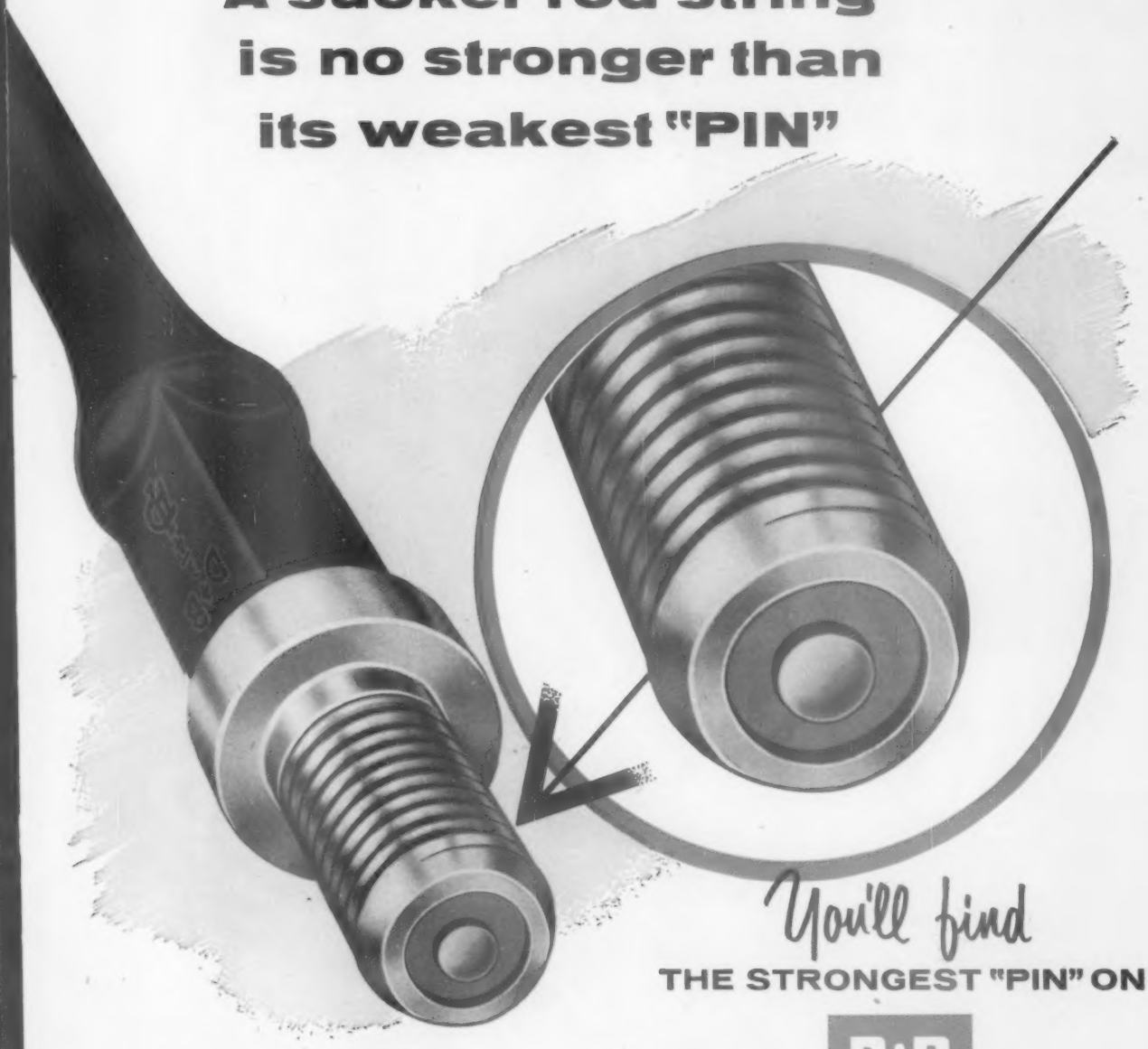
Editorial in the Washington Post and Times-Herald.

Education and the Technical Man

"Even at the cost of adding another year for a scientific degree, I feel it is most important that our technical graduate should have a more liberal education so as to be able to understand his environment better and be able to take into better account the social, economic, and political aspects of his professional work.

"The greater the impact of science and technology upon our society the greater is the need for broader horizons for our technical people, and this is most particularly essential if the tech-

A sucker rod string is no stronger than its weakest "PIN"



You'll find

THE STRONGEST "PIN" ON

D+B

SUCKER RODS

Careful threading, quality control and highest grade materials combine to make D+B Sucker Rod Pins the most dependable in the industry. Call or see your nearest Continental-Emsco Store for full details.

CONTINENTAL-EMSCO

Serving the Oil and Gas Industries .. Worldwide

D+B

- DEEP WELL PUMPS
- SUCKER RODS
- COUPLINGS

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Representatives in All Principal Oil Fields of the World

SR-702

NORDBERG

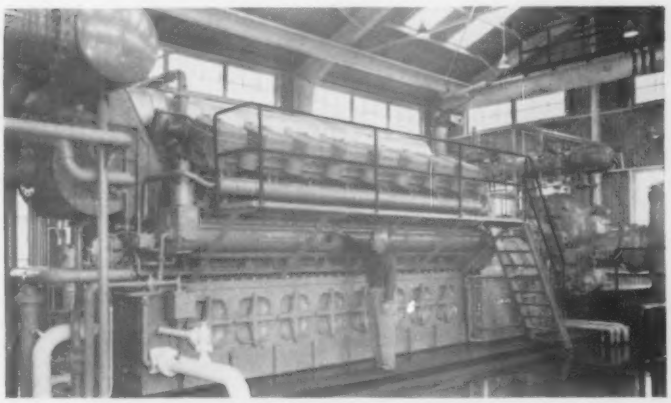
MEMO TO: Management
After investigation and full consideration of all facts this committee recommends the installation of Nordberg engines for this pipeline project.
Chairman, Technical Committee
Dick Carlton

The Scene: Office of the Vice President in Charge of Operations, major gas transmission company.

The Problem: Selection of engine compressor units for gas pipeline expansion.

Recommendation: Install Nordberg *Supairthermal*® gas engine gear sets driving centrifugal gas compressors.

The Reason: Because the Nordberg units can be installed with lower capital investment, and operated at lower cost per horsepower-hour.



Nordberg Supairthermal Engines are, by all standards, your best investment in modern prime movers for compact, economical, long term pipeline power. These powerful engines are built in both In-line and V-types, in sizes from 500 to 4,500 horsepower for Diesel, Duafuel® or Spark-Ignition Gas operation.

Consult Nordberg on your next expansion program.

NORDBERG MFG. CO., Milwaukee, Wisconsin

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

©1957, Nordberg Mfg. Co.

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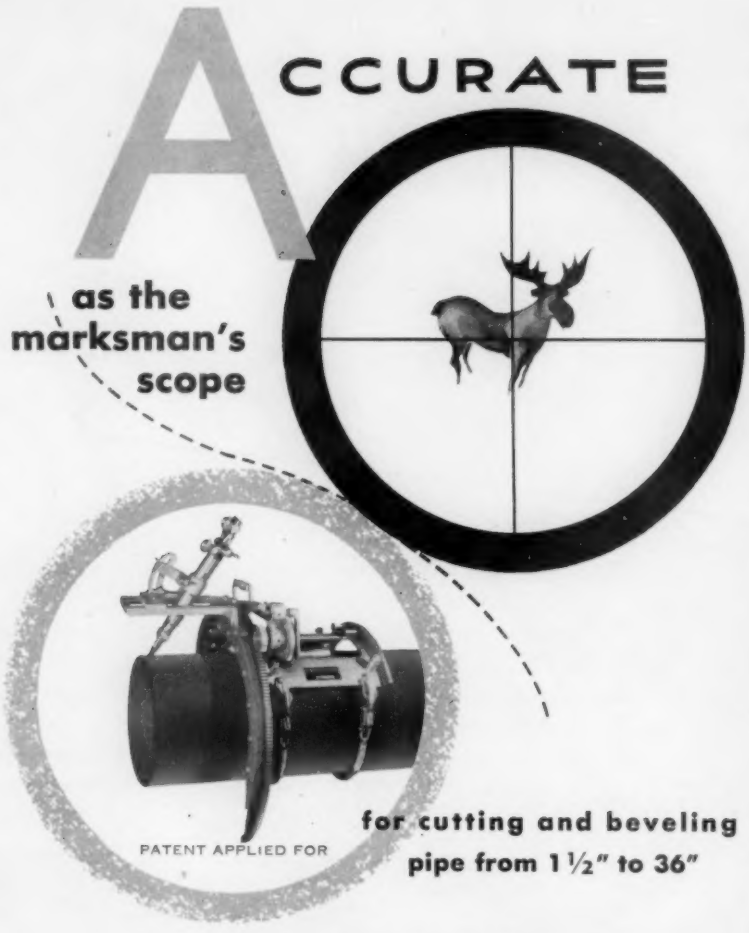


PIPE CUTTING AND BEVELING MACHINES

The precision, accuracy and speed of preparing **perfectly square joints** for welding pipe from 1½" to 36" — is unequalled when you use H & M Pipe Cutting and Beveling Machines — **in the field or in the shop!**

Extremely light in weight, yet rugged enough for the toughest job, H & M Machines are so simple to operate that anyone who can light an acetylene torch can make perfect cuts of any size pipe after only a few minutes of instruction!

The split horse-shoe gear construction of H & M Machines allows them to slip easily over any section of pipe for quick, unerring cutting and beveling at any desired angle.

Savings of one-half the cost in **labor-gas-and-time** in comparison to manual-cutting — makes H & M Pipe Cutting & Beveling Machines the most valuable equipment wherever pipe is welded!

All H & M Machines can be easily and quickly motorized for automatic operation.

Write for illustrated bulletins.

H&M PIPE BEVELING MACHINE COMPANY

TULSA, OKLAHOMA

Trademark Registered

311 E. Third St. Diamond 3-0241

nical graduate ends up—as so many do — in administrative and executive work in the business world."

M. J. Rathbone, president, Standard Oil Co. (N.J.), in a speech accepting the Stevens Honor Award of Stevens Institute of Technology, Hoboken, N. J.

This Experiment Bears Watching

"The development of the petroleum industries in the various countries of the Far East and the Near East in the immediate future will be closely dependent upon political development in these countries.

"... Unsettled political outlook and strong nationalistic feelings of many countries create atmospheres in which private industry may be loathe to make the heavy investments necessary to develop the natural resources. Several countries have elected to attempt to develop oil industries through government agencies. India is the latest to attempt such a nationalistic venture, and with no previous experience or trained personnel she apparently looks to Russia for technical and material aid to build up a government-owned petroleum agency from 'scratch.' Private industry and many Asian and African countries will watch this experiment with considerable interest."

Harry W. McCobb, vice president and a director of Standard-Vacuum Oil Co., in a speech before the annual meeting of American Institute of Mining, Metallurgical and Petroleum Engineers, petroleum branch, New Orleans.

Water-Flood Predictions Bright

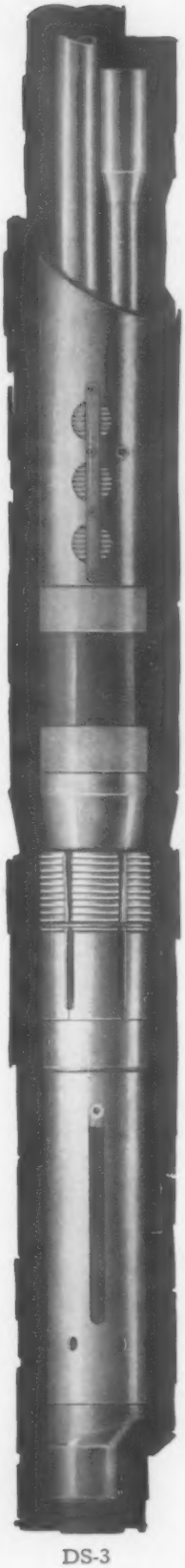
"Not all oil formations are susceptible to secondary-recovery operations, but it is conservatively estimated that more than 65 per cent of all known reserves in the United States and Central America can be successfully water flooded. I don't need to romance you on the magnitude of this potential recovery of oil . . . and the amount of dollars connected with it . . . it's in the billions of barrels and billions of dollars."

W. H. Davison, president, Tekoil Corp., in a speech before the Philadelphia Securities Association.

Where Credit Is Due

"American oil is saving Western Europe from the winter. Europe is not getting as much oil from America as it wants and actually needs—and, of course, is blaming us for the shortage caused by the Anglo-French foray into Suez—but it will not freeze until the canal is reopened and the broken pipelines are mended, thanks to a private industry.

"America, we have been assured, cannot fight another world war on its



DS-3

BROWN was first!

BROWN OIL TOOLS pioneered in the design and manufacture of the first successful dual parallel, detachable string packer.

Others may copy, but experience counts most when you have a parallel string completion coming up.

BROWN OIL TOOLS now has several different types of parallel detachable string packers, tailor-made to meet any and all specific requirements for your well.

The DS-2 and DS-8 are field proved cup-type packers, which require no weight or surface manipulation to set. Only well pressure differentials are required to effect a leak-proof seal and firmly anchor the slips in either direction.

For wells where compression type seals and mechanically set slips may be preferred, BROWN OIL TOOLS has the DS-3 and DS-4 with lead seals added above and below the rubber seal for additional sealing surface and safety.

The DS-3 has a built-in hydraulic hold-down, for wells with very high pressures. This hold-down eliminates the need for heavy tubing loads to anchor the packer firmly.

The DS-4 (DS-3 without hold-down) has proved very successful in average pressure wells under such conditions as deep swab-downs and gas lift—without leaks or tubing kinks.

If you need help, call BROWN. BROWN has the over-all manufacturing experience and field know-how.

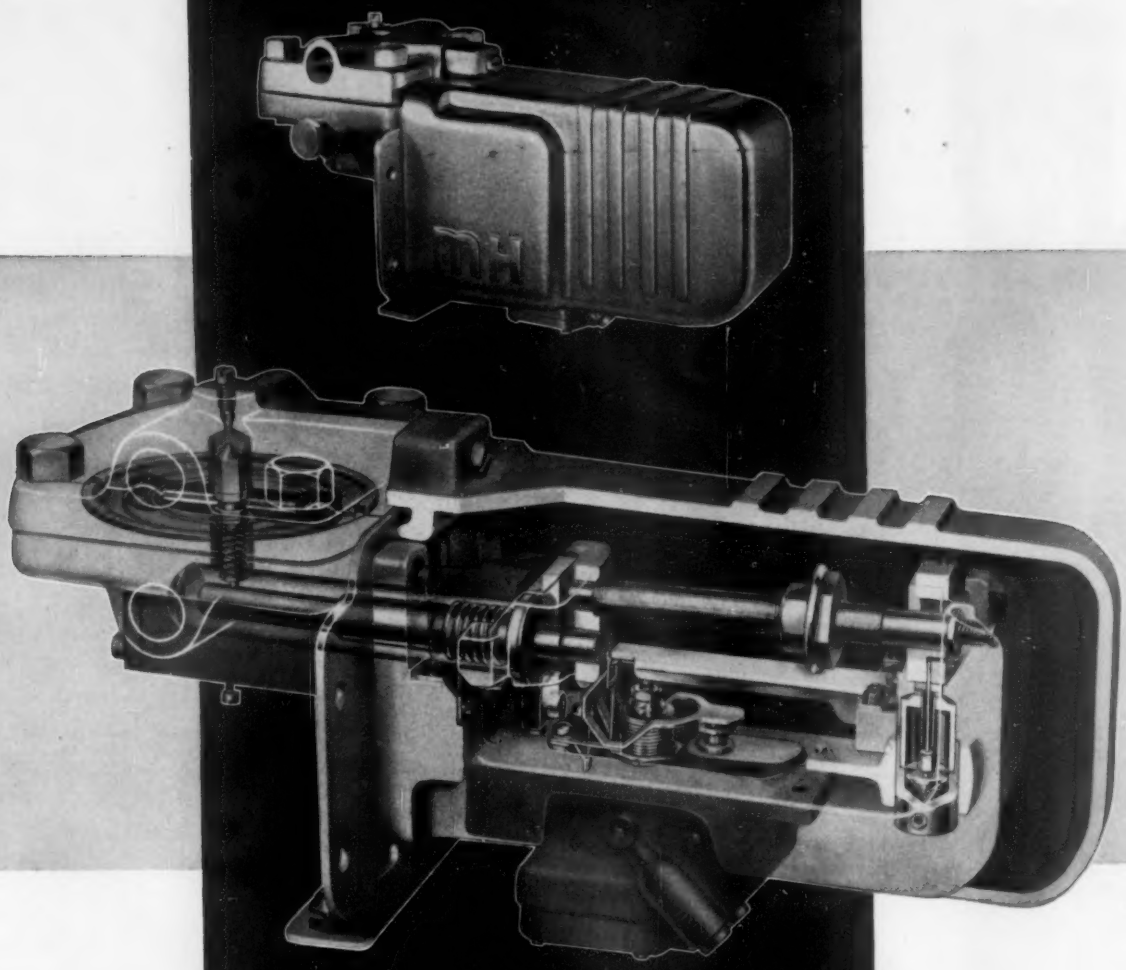
BROWN OIL TOOLS, INC.

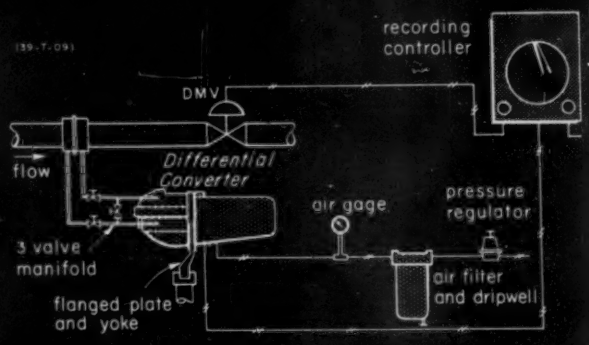
8490 KATY ROAD **HOUSTON, TEXAS**

Brown Service Locations TEXAS: Corpus Christi, Kilgore, Snyder, Victoria, Wichita Falls. OKLAHOMA: Ardmore, Oklahoma City. LOUISIANA: Harvey, Houma, Lake Charles, Monroe, New Iberia, New Orleans, Shreveport. KANSAS: Liberal.

Representatives MWL Tool & Supply, Midland, Texas and Hobbs, N. Mexico. Regan Forge & Engr. Co., San Pedro, Calif.

Export Offices Acme Well Supply, New York City. Import Tool Co., Edmonton and Calgary, Alberta, Canada. A-Z Export, S.A., Maracaibo and Puerto LaCruz, Venezuela. Miguel Rocca, Mexico City.





Locally mounted transmitter can be connected to recording (or indicating) controller, which can be near orifice or at remote location. Recorder without control can be located up to 1,000 feet from transmitter.

Closer Control of Flow and Liquid Level

...with Honeywell's Differential Converter

USE THIS mercuryless remote transmitter for practically *any* application requiring precise, high-speed measurement of flow or liquid level. It's accurate within 1%. Equally fast in response up the scale or down. Range is continually adjustable in the field. Mount this compact, lightweight unit anywhere.

The *Differential Converter* operates on the force-balance principle, transmitting by a single air line to a pneumatic receiver as far as 1,000 feet away. It's the ideal companion for Honeywell *Tel-O-Set* miniature recorders, indicators and controllers.

For details on how *Differential Converters* make possible tighter control in your most critical applications, call your nearby Honeywell sales engineer today. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

For measuring liquid level in closed tanks: One model with a normal range of 0-14 to 0-200 inches of water, and two suppression ranges of 0-75 and 50-200 inches. Suppression spring permits direct, instead of reverse, reading of instrument.

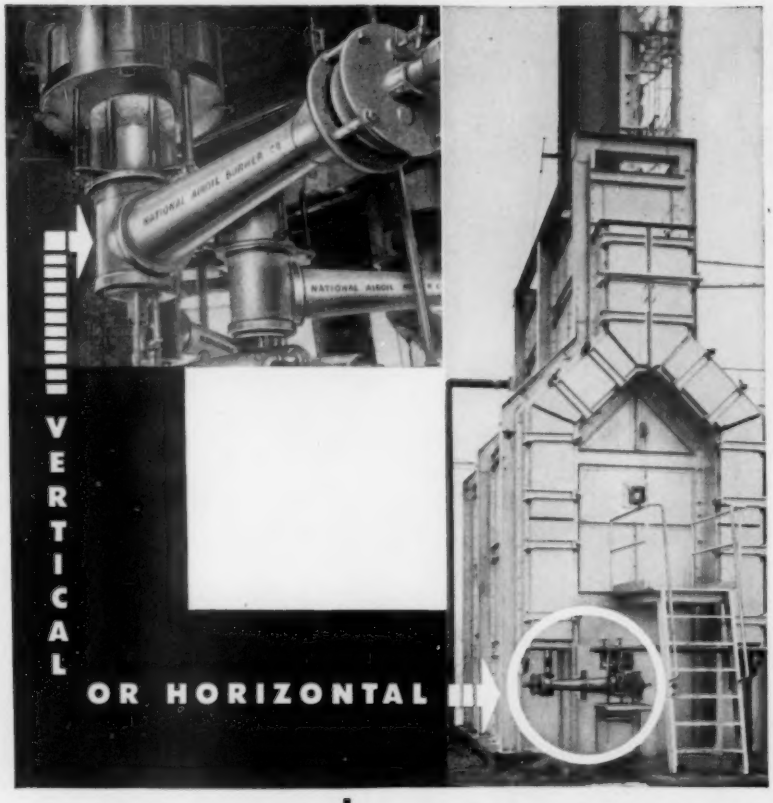
For measuring flow and liquid level in open tanks: Two models with ranges from 0-20 to 0-200 inches of water differential and 0-100 to 0-1000 inches.

● **REFERENCE DATA: Write for Bulletin 2290-1, "*Differential Converter* Liquid Level Transmitter"; Catalog 2321 "Flow Meters"; and Specification 240, "*Differential Converter* Flow Transmitter".**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls



many more hours on stream without forced shutdown with NATIONAL AIROIL

OIL-GAS TANDEM COMBUSTION UNITS

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . *plus:* special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL or HORIZONTAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT'S clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

NATIONAL AIROIL BURNER CO., INC.

CHEMICAL-PETROLEUM DIVISION

Main Office & Factory: 1236 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

own oil, but it can meet a crisis that threatens to destroy Western Europe economically quite as thoroughly as war would do it.

"And for this the private oil industry of the United States deserves most of the credit—although the politicians will be reluctant to give it."

Editorial in the Los Angeles Times.

Atomic Competition for Oil?

"Once atomic power has been demonstrated to be practical and economic in a commercial operation, this new industry should be headed for rapid growth. Because of the characteristics of atomic energy, I have the impression that the plans for the commercial application of atomic energy, and estimates of operating performance generally have been conservative, which they should be.

"For example, all AEC production reactors have given vastly better operating results and better economy than estimated at the time they were designed. The Nautilus has had more than 50,000 miles of cruising duty and the fuel elements have not yet been replaced. Originally, 10,000 miles were estimated as being a satisfactory minimum. Other reactors have also operated at power levels much higher than design specifications.

"If the performance of industrial power reactors follows this pattern, we may not be far from competitive atomic power."

Jesse C. Johnson, director, division of raw materials, U. S. Atomic Energy Commission, in a speech before the National Western Mining Conference, Denver.

Disappointing Exploration Year?

"From the standpoint of the number of exploratory tests found to be productive, the results of 1956's exploration were somewhat disappointing.

"About 1,600 of the exploratory tests resulted in the discovery of oil in commercial quantities, almost 500 were completed as gas wells, and almost 11,000 were dry.

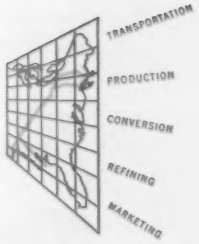
"The number of tests which found oil was lower than in 1955, and the number which discovered gas was greater. The percentage of wildcats found to be productive of oil or gas was about 16 per cent, less than the 17.7 per cent of 1955's exploratory wells which were credited with the finding of new reserves."

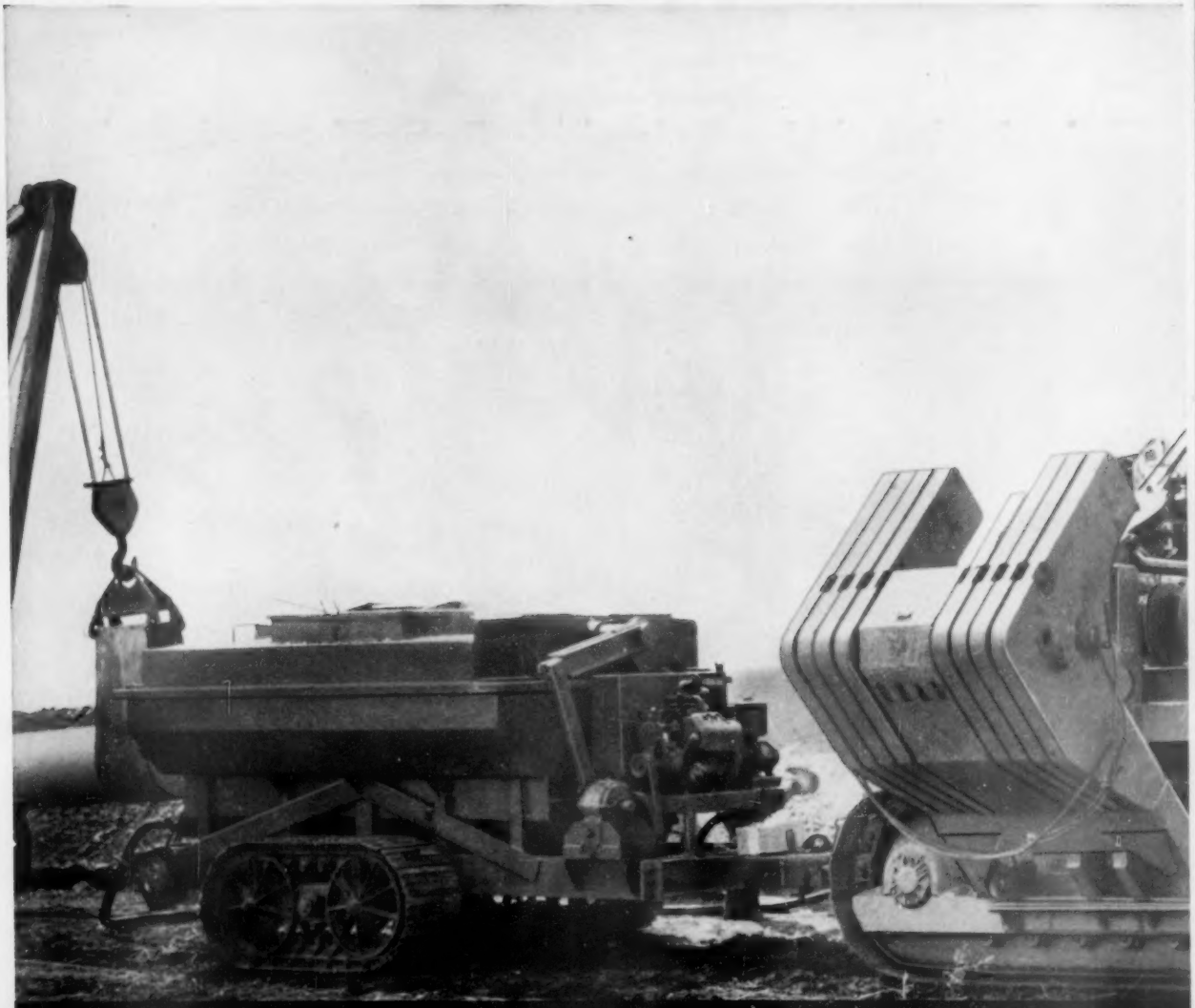
Report of the Production Review Committee of the American Institute of Mining, Metallurgical and Petroleum Engineers, petroleum branch, presented at the A.I.M.E.'s annual meeting in New Orleans.

PRIME SOURCE

The humming bird seeks the flower for food.
So fuel-hungry America looks to natural gas and oil for energy.
To fuel its furnaces, drive its cars, heat its homes, cook its food.
Today Tennessee Gas, operator of the nation's longest pipeline, also
is active in other basic phases of gas and oil . . . exploration, production . . .
extraction, conversion . . . refining, marketing. Fully equipped to
help supply the services and products that mean better living.

TENNESSEE GAS TRANSMISSION COMPANY
AMERICA'S LEADING TRANSPORTER OF NATURAL GAS
HOUSTON, TEXAS





KEEP PIPE HANDLING COSTS DOWN . . .

Torque converter drive . . . matches power and speed to job requirements automatically . . . cushions entire power train and mounted equipment.

Double-reduction final drive and smooth underside . . . give extra clearance for working on irregular terrain.

1,000-hour lubrication intervals for truck wheels . . . eliminate daily greasing . . . convert maintenance time to working time.

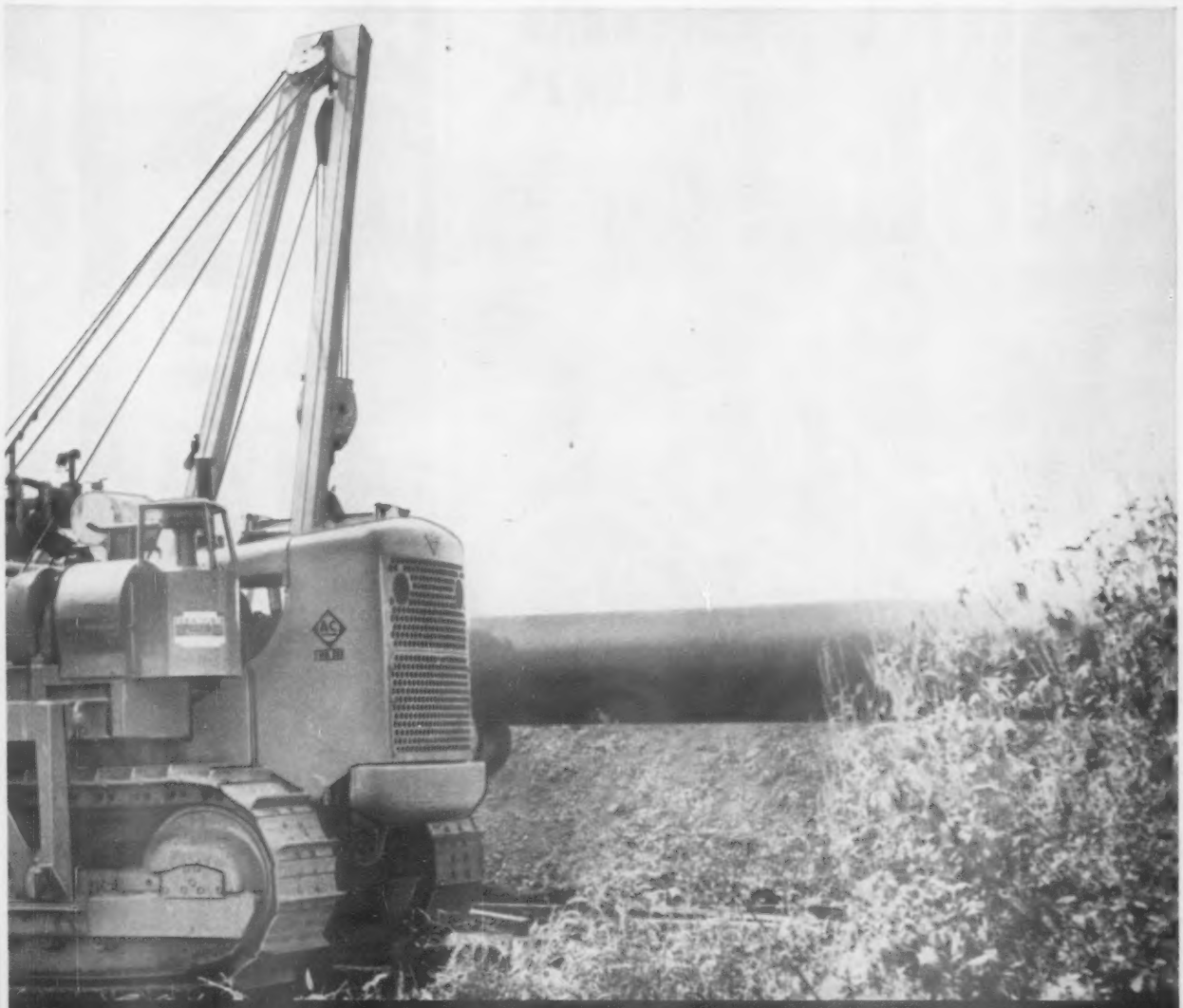
One-piece steering clutch and final drive housing . . . insure perfect gear alignment, long life.

Unit construction . . . major assemblies can be removed without disturbing adjacent parts . . . makes service simple, fast.

Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

Just a few of the basic advantages that help this Allis-Chalmers Tractor-Tractomotive side boom

ALLIS-CHALMERS ***. . . crawler tractors***



. . with help like this!

Internal expanding brakes . . . protected from dirt and water . . . provide positive control of load and boom line drives.

Safety link extendable counterweights . . . controlled hydraulically and mounted high for maximum clearance.

Convenient controls . . . easy operating, positive, conveniently located.

Quick-on, quick-off sectional boom frames . . . pin-connected for fast attachment or removal for transport.

Simplified transmission . . . one lever switches boom or load line from raise through neutral to power down—no gear shifting necessary.

Tractomotive Corporation, Deerfield, Illinois.

combination speed output . . . give you bigger profits. Now is the time to have them working for you.

TRACTOMOTIVE ***. . . side booms***

new book

gives you the facts on

modern

OUTBOARD POWER

for

oil field

service

TODAY there's a *new kind* of outboard power for work boat duty! A complete line of new Evinrude *Aquasonic* models so advanced in capability, stamina, and smooth, quiet operation that they set entirely new standards of performance. Get the facts! Send coupon for booklet.

EVINRUDE MOTORS
Division of Outboard, Marine & Mfg. Co.
4632 N. 27th Street, Milwaukee 16, Wisconsin

Send me booklet on outboard power for work boat duty.

Name.....

Address.....

City.....Zone...State.....

(In Canada: Mfd. by Evinrude Motors of Canada, Peterborough)

CALENDAR OF EVENTS

MARCH

11-21 Quality Control by Statistical Methods, tenth annual short course, sponsored by University of Illinois, College of Engineering and Division of Engineering Extension, Champaign, Ill.

12-13 Subsurface Geology Symposium, fifth annual conference, sponsored by the University of Oklahoma, Norman, Okla.

13-15 Society of Exploration Geophysicists tenth annual mid-western meeting, Hotel Texas, Fort Worth.

14 American Society for Testing Materials, New York district meeting, New York City.

18-21 American Society of Mechanical Engineers, national conference, gas-turbine power division, Sheraton-Cadillac Hotel, Detroit.

20-22 American Petroleum Institute, southern district production division meeting, Washington-Youree and Captain Shreve Hotels, Shreveport, La.

25-27 Western Petroleum Refiners Association, annual meeting, Hilton Plaza Hotel, San Antonio, Tex.

25-29 American Society for Metals, Western Metal Exposition and Congress, Ambassador Hotel and Pan-Pacific Auditorium, Los Angeles.

27-29 American Power Conference, Sherman Hotel, Chicago.

30 North Texas Oil and Gas Association, twenty-seventh annual meeting, Kemp Hotel, Wichita Falls, Tex.

APRIL

1-4 American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, national convention, Kiel Auditorium, St. Louis.

2-4 Corrosion Control, fourth annual conference, sponsored by National Association of Corrosion Engineers and the University of Oklahoma College of Engineering, University of Oklahoma, Norman, Okla.

7-10 Petroleum Equipment Suppliers Association, annual convention, Palm Springs, Calif.

7-12 American Chemical Society, national meeting, Miami, Fla.

8-10 American Society of Mechanical Engineers, spring meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.

9 American Institute of Chemical Engineers, Philadelphia-Wilmington section, University of Pennsylvania, conference on catalysis in practice, University Museum, Philadelphia.

9-11 American Welding Society, fifth annual welding show, Convention Hall, Philadelphia.

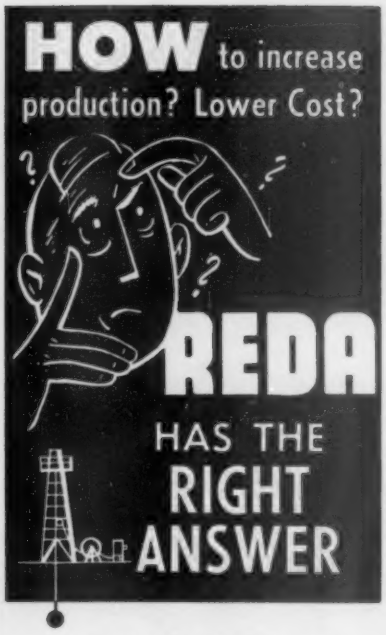
10-12 American Petroleum Institute, Mid-Continent district production division meeting, Mayo Hotel, Tulsa.

11-12 West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Tex.

11-13 Institute of Radio Engineers, ninth annual southwestern I.R.E. conference and electronics show, sponsored by Houston section, Shamrock Hilton, Houston.

11-13 Institute of Radio Engineers, second national simulation conference, sponsored by Professional Group on Electronic Computers, Shamrock Hilton Hotel, Houston.

11-13 American Institute of Mining, Metal



. . . from ⅓ HP to 300 HP . . . from 20 bbls to 25,000 bbls . . . from 200' to 10,000' and more . . . Yes, a REDA will do that pumping job BETTER . . .

Reda Pumps are used as original equipment, or replacement equipment, because they produce at a lower cost per barrel of fluid. Whether it's large volumes from shallow depths, or modest volumes from great depths, Reda Pumps provide operating savings.

IMPROVED DESIGN:

Constant research and design improvement are responsible for lengthened operating life, corrosion resistance, low labor cost per barrel of fluid produced.

IMPROVED EFFICIENCY:

Greatly improved overall efficiencies have improved Reda performance as much as 25%; a substantial operating saving.

If you have a pumping problem, our engineering staff is always ready to assist you. Phone or write:

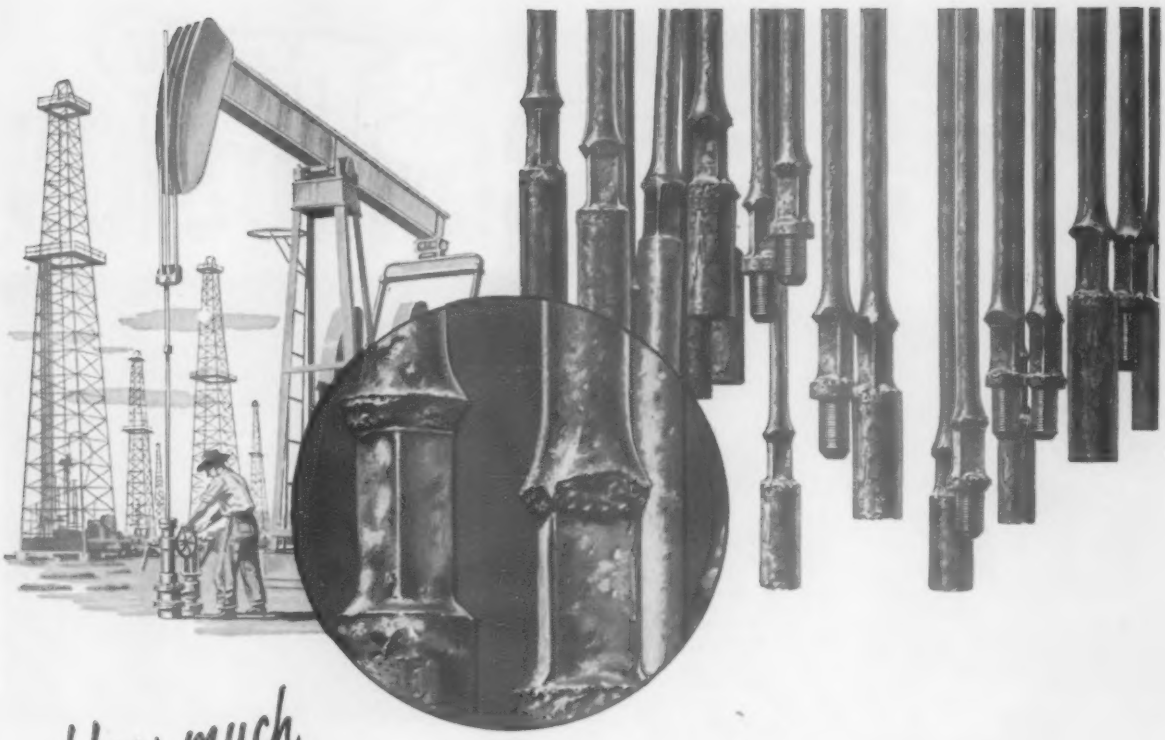
THE SIGN OF QUALITY

SUBMERGIBLE REDA PUMPS

REDA

PUMP COMPANY

BARTLESVILLE, OKLAHOMA



How much

does rod and tubing corrosion cost you?

Every time you pull rods and tubing, corrosion is cutting into your profit . . . not only in direct costs for labor and materials, but in lost production that you may never recover.

Stop losses with Cronox inhibitors

A small investment in corrosion prevention can pay off in big savings. Start the right program now—by having an Aquaness man study the corrosion problems of your well. He's thoroughly familiar with ways to tackle every kind of well—flowing, pumping, condensate; with and without packers; high water or low. He has a line of CRONOX inhibitors that cover every combination of well requirements. And he knows how to put them to work for you, by setting up and implementing a test program that determines which CRONOX product best fits your well, and that checks performance on a regular schedule.

Call your local Aquaness representative for a consultation on your specific corrosion problems.

Write for a copy of the new booklet, "CRONOX Corrosion Inhibitors"

Aquaness Department
ATLAS
ATLAS POWDER COMPANY
2005 Quitman Street, Houston 26, Texas

These two Young VSF-211 units at a pipeline compressor station are cooling engine jacket water at a capacity of 18,800,000 BTU/hr per cooler. The photo at left shows a typical fan.

Young VSF Coolers Provide Extra Capacity, High Efficiency in Pipeline Service

Young VSF Coolers combine vertical air discharge with space saving design — that means *extra large capacity* for you.

Vertically mounted coils utilize local wind movement in minimizing fan horsepower and rolling doors over face of cores help maintain close regulation of temperature due to seasonal conditions. Further fan horsepower savings are produced by the multi-fans which accurately regulate airflow.

Young can meet your individual requirements because coils are available in a variety of standard tube sizes and lengths. Young VSF units are used for water, oil, or gas cooling . . . steam or vapor condensing . . . or almost any combination of cooling or condensing services.

Write Dept. 207-C for FREE Catalog

Young RADIATOR COMPANY

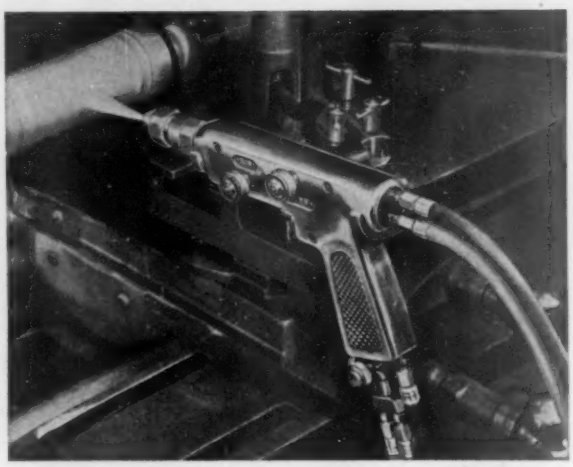
RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY

Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

STOP CORROSION

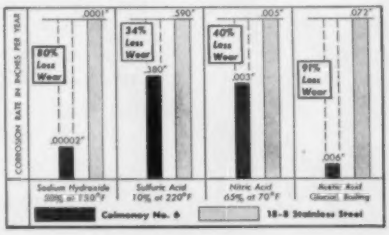


with Colmonoy Spraywelding

The superior corrosion resistance of Colmonoy No. 6 alloy makes it the ideal hard-facing material for use on surfaces undergoing metal-to-metal wear under corrosive conditions, such as pump and valve parts.

The Colmonoy Spraywelder puts No. 6 on fast, in powder form. It makes smooth overlays within .010" of desired size, requiring a minimum of finishing. Sprayweld overlays are solid and welded to the base metal.

The corrosion of vital process equipment parts becomes needless waste when the wear resistant qualities of Colmonoy No. 6 are combined with the economy and ease of the Spraywelder.



This table shows the comparative resistance to corrosion of Colmonoy No. 6 and 18-8 stainless steel. No. 6 is resistant to almost all caustics and acids. Ask for Engineering Data Sheet No. 3.

WRITE RIGHT NOW

For the Colmonoy Spraywelder Catalog and Hard-Facing Manual No. 79

HARD-FACING & BRAZING ALLOYS

WALL COLMONOY CORP.

19345 JOHN R STREET - DETROIT 3, MICHIGAN

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MORRISVILLE, PA. - NEW YORK - PITTSBURGH - MONTREAL - GREAT BRITAIN

lurgical, and Petroleum Engineers. Pacific Northwest Regional Conference, Portland, Ore.

16-18 Petroleum Industry Electrical Association annual meeting, Shamrock Hilton Hotel, Houston.

16-18 Petroleum Electric Suppliers Association, Shamrock Hilton Hotel, Houston.

16-18 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla.

16-18 National Petroleum Association, fifty-fourth semiannual meeting, Cleveland.

18-19 Texas Petroleum Research Committee and Permian Basin Section of American Institute of Mining, Metallurgical, and Petroleum Engineers, tenth annual oil-recovery conference, Midland, Tex.

22-25 Canadian Institute of Mining and Metallurgy, annual general meeting, Chateau Laurier, Ottawa.

24-26 Natural Gasoline Association of America, thirty-sixth annual convention, Rice Hotel, Houston.

24-26 American Petroleum Institute, Rocky Mountain district production division meeting, Gladstone, Townsend, and Henning Hotels, Casper, Wyo.

25-27 Appalachian Geological Society, Kentucky Geological Society, joint field conference, southeastern Kentucky.

25-27 American Association of Petroleum Landmen, third annual convention, Hilton Hotel, San Antonio, Tex.

28-30 Independent Petroleum Association of America, midyear meeting, Buena Vista Hotel, Biloxi, Miss.

29-30 Automatic Control in the Petroleum and Chemical Industries, conference sponsored by the University of Oklahoma, extension study center, University of Oklahoma, Norman, Okla.

29-May 1 Southern Gas Association, annual convention, New Orleans.

MAY

1-3 American Petroleum Institute, Division of Production, eastern district meeting, William Penn Hotel, Pittsburgh.

6-8 American Petroleum Institute, annual pipeline conference, Cleveland Hotel, Cleveland.

6-8 American Geophysical Union, thirty-eighth annual meeting, National Academy of Sciences, Washington, D. C.

7 American Gas Association, committee on underground storage, operating section, Mark Hopkins Hotel, San Francisco.

8-10 American Gas Association, Pacific Coast Gas Association, gas supply, transmission, and storage conference, Mark Hopkins Hotel, San Francisco.

9-10 Symposium on use of surface active agents in water flooding, Pennsylvania State University, department of petroleum and natural gas, State College, Pa.

12-15 Liquefied Petroleum Gas Association, annual meeting, Conrad Hilton Hotel, Chicago.

13-15 Industrial Waste Conference, sponsored by Purdue University, Purdue Memorial Union Building, Lafayette, Ind.

13-16 American Petroleum Institute, division of refining, midyear meeting, Sheraton Hotel, Philadelphia.

14-16 Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and Nucleonics Magazine, Museum of Science and Industry, Chicago.

16-17 American Petroleum Institute, division of production, Pacific Coast district meeting, Hotel Biltmore, Los Angeles.

19-22 Texas Independent Producers and Royalty Owners Association, Galvez and Buccaneer Hotel, Galveston, Tex.

20-22 American Petroleum Institute, division of transportation, central committee on transportation by water and tanker corrosion symposium, San Francisco.

20-22 American Gas Association, chemical, engineering, and manufactured gas production conference, Balmoral Hotel, Bal Harbour, Fla.

20-23 American Society of Mechanical Engineers, twenty-ninth annual conference and exhibit of the oil and gas power division, Kentucky Hotel, Louisville, Ky.

21-23 Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa.

23-24 Kentucky Oil and Gas Association, annual membership meeting, Hotel Phoenix, Lexington, Ky.

23-24 American Institute of Mining, Metallurgical, and Petroleum Engineers, third annual joint meeting, Rocky Mountain petroleum sections, Northern Hotel, Billings, Mont.

23-24 Western Petroleum Refiners Association, southwest regional technical-industrial relations meeting, Hotel Paso del Norte, El Paso, Tex.

29-31 Annual short course in gas technology, Texas College of Arts and Industries, Kingsville, Tex.

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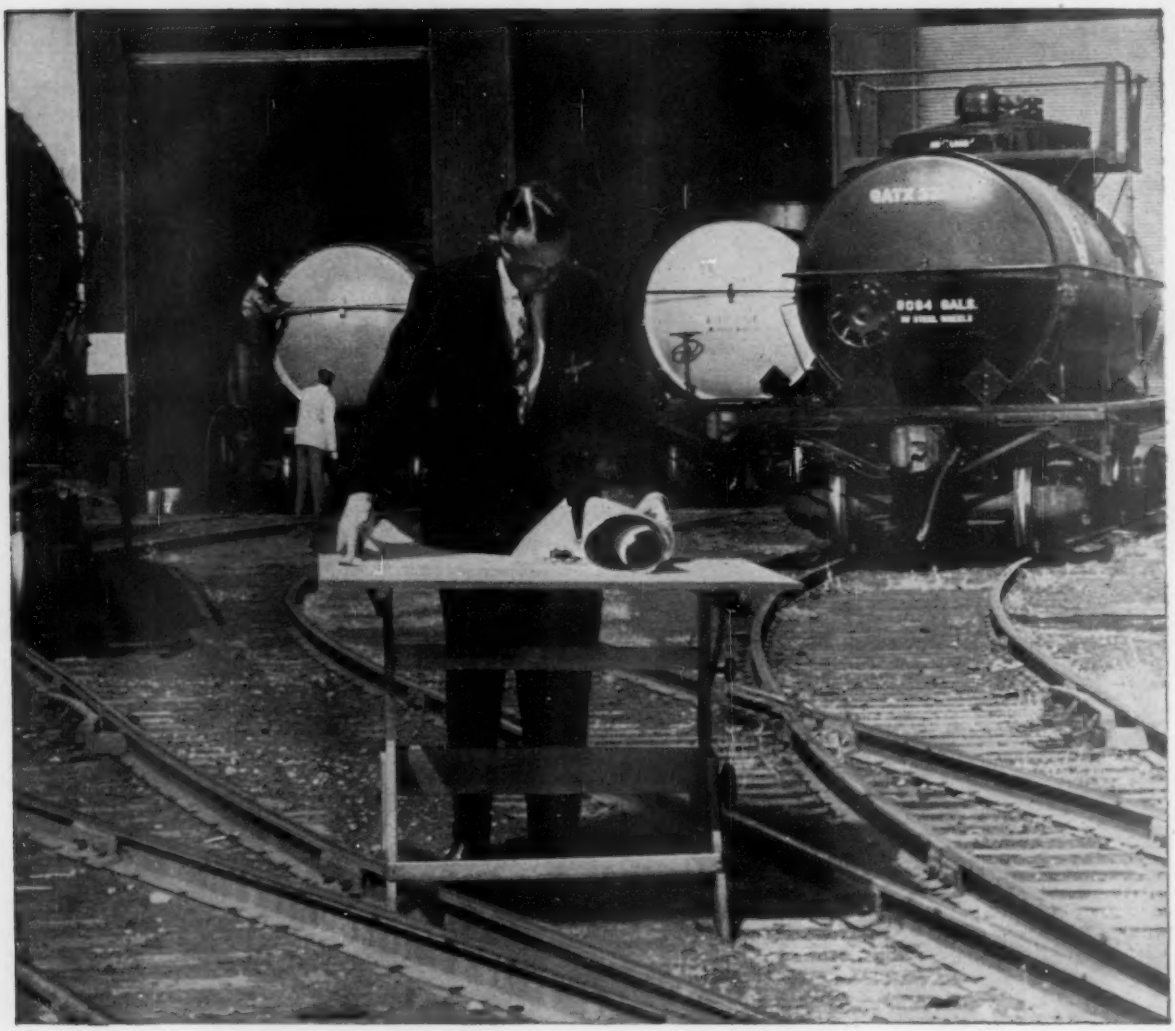

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JOURNALLY SPEAKING . . .

One-Man Campaign

LOTS of people complain that the oil industry's public-relations program is ineffective in influencing the molders of public opinion.

But there's one Texan in Washington, D. C., who is doing something about it. Single-handedly he is going to bat for the industry against the unfair attacks on it by the journalistic giants of the nation's capital.

The hero of this David-and-Goliath act isn't an oil man and he doesn't own any oil wells. He's just a civil-service employe of one of the Government bureaus. But he was raised in Texas and he knows the oil industry, and he's proud of both.

And he can write letters. He writes letters to the editors of the Washington papers every time they print an editorial or a column that puts oil in a bad light. His letters give facts about oil and tell the industry's side of the story. They are so clear and convincing that the papers print some of them.

This man's name is J. N. McKean, but it could be Joe Doakes or anything else. The point is that here is a private citizen who has enough interest in truth and fair play to dig out a few facts, and enough gumption to speak his mind to his neighbors and particularly to his local newspapers.

Syndicated columnists are a favorite target for McKean. Here are some excerpts from one of his letters the Washington Star printed:

"Doris Fleeson has again put her evil eye on the oil industry. I object to Miss Fleeson's opinions not so much because of what she says is the oil industry's failure to deliver oil to Europe in required quantities but for the basis of her reasoning, or rationalizing, from which she draws her conclusions.

"She says the question is whether the oil industry or the Eisenhower administration is properly to be blamed for this situation. That leaves no choice. Somebody's gotta be blamed.

"Miss Fleeson also threw in her usual double whammy against 'tax allowances and privileges' (presumably the depletion allowance) which she says sets the oil industry apart from other segments of industry.

"The point she misses is the fact that mostly because of these 'privileges' does the oil industry have the excess producing capacity to supply the missing oil at all."

And here's what he wrote the Washington Post & Times-Herald, the capital's only morning newspaper, about an editorial jumping on the industry for raising prices:

"If I were running your newspaper and doing as much screaming about freedom of the press as you do, I would examine the issues of the case a little closer before I tagged the oil companies a bunch of highbinders.

"I'm no more overjoyed than you are about paying any more than I have to for gasoline or heating oil. In fact, I haven't been just real happy about paying $1.95 a month for the Washington Post.

"And I imagine your advertisers could add another verse. How many notices have they received from you since the war like: 'We are sorry to advise you that, because of another increase in the price of newsprint, metal, wages, etc., it is necessary to readjust our rates.'

"In fact, you might compare some other prices and percentages of increase against this 'oil fiasco' you are so upset about, and see how they stack up.

"This feud between the big international oil companies and the domestic or independent companies, as you report it, at least is some proof that there is still competition in that industry.

"There once was another morning newspaper here, too."

For our money, this sort of thing is far more effective than any formal public-relations campaign. Editors are much more influenced by personal letters from their subscribers than by mimeographed press releases from hired press agents.

If more individual citizens—be they oil men, Texans, or anybody interested in fair play—would speak out like J. N. McKean, the industry's public-relations problems would virtually vanish.

—Henry D. Ralph.

Exactly Right!

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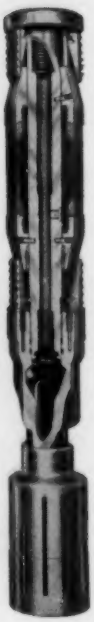

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Don't call quits on a gas bill now

THERE'S a disturbing attitude of defeatism in the industry on new natural-gas legislation, even though it is constantly more obvious that expansion of the gas business will be throttled without it.

Two months ago the White House said that new legislation is necessary. Then the Federal Power Commission recommended sweeping changes in the present law to relieve independent producers of nearly all its present restrictions.

Now an informal committee of producer, distributor, and pipeline interests has reached full agreement on a draft of a bill under which they can all live and prosper and which they feel protects the public interest. The draft is an improvement on the vetoed Harris-Fulbright bill and is in line with the objectives of the White House and the FPC.

YET THERE IS PESSIMISM. In spite of all this support and unanimity, sponsors of the industry bill are so afraid of defeat that they wonder whether it is worth while even having it introduced in Congress.

Informal polls indicate that roughly half the Congressmen may oppose any gas bill whatever—even a bill they haven't seen yet. Those who favor legislation don't want to push it if it looks like tough going.

Some individual companies among producers, distributors, and pipelines are not satisfied with either the FPC or the industry-committee proposals. They are already sniping at them as a whole or demanding amendments.

But the greatest deterrent is fear of opposition outside of Congress and outside of the industry. It is the opposition from mayors, state officials, self-appointed champions of consumers, and "liberal" publicists—opposition from people who think that any lessening or even simplification of federal regulation of business just must be bad.

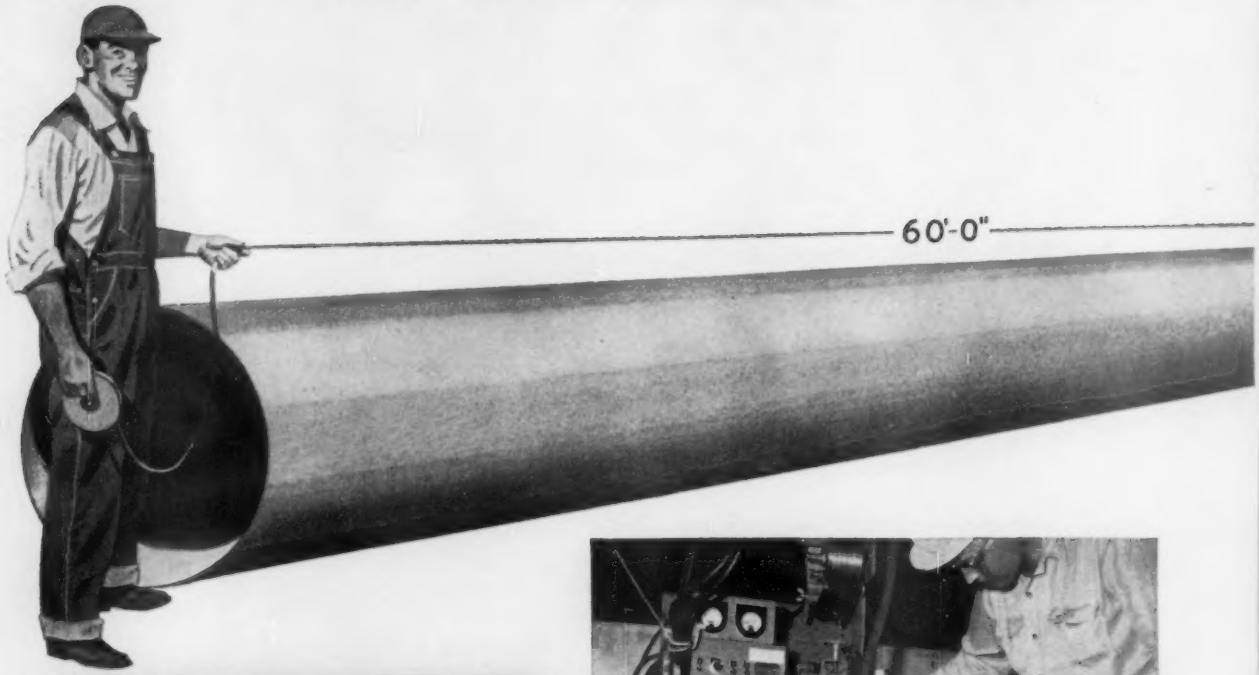
Facing such hurdles, and still bruised from the beating they took last year, the gas industry and its friends in Congress have little stomach for a fight. Many of them think they are licked before they start, and advise dropping the whole thing until some other year.

THIS IS A SORRY SITUATION. The industry is still in the right, and the justness of its cause is more apparent than ever. It has a more acceptable, more practical bill than last year. And it has more unanimity and support.

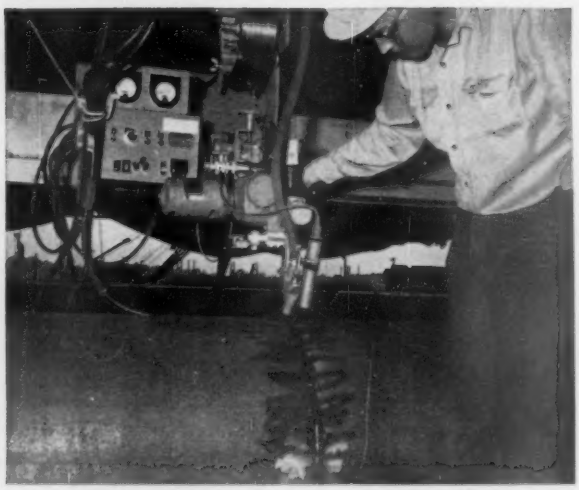
This is not the time to quit. Running away from the problem won't solve it. Quailing before the opponents won't quiet them.

The industry must have the courage of its convictions. There's nothing to lose. No ground is ever gained by sitting still. With head unbowed though bloody, the industry should reengage the enemy now.

NEW "SUPER-SPAN" JOINTS LINE PIPE *speed schedules*



Stringer bead for joining two 30-foot joints of Republic Electric Fusion Weld Line Pipe is applied at "line-up" station. Perfect alignment is possible with precise separation of lands on rust-free bevel. Note rubber-tired rolls used to cradle pipe.



Here the first of two fully automatic passes is made by submerged arc welding, employing latest equipment and methods. The finished mid-weld of Republic's new "Super-Span" Pipe is as reliable as the longitudinal weld.

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Sixty feet in length, these extended joints of Republic Fusion Weld Pipe require only 88 welds to make up a mile of line. Progressing at the rate of 150 girth welds per day—about par for welding-crews under normal conditions—daily production will total 9000 feet.

Compare this to the 6000 feet of line you complete using 40-foot joints. It adds up to a minimum savings of 33% in laying time when you use the new Super-Spans. In a 500-mile line, for example, the *savings* would amount to *147 working days!*

This new, economical length, a Republic exclusive, is produced by joining two 30-foot joints under ideal welding conditions. Each welding operation is carefully controlled, resulting in a mid-weld of equal quality to the longitudinal weld.

Consistent uniformity like this is standard in every joint of Republic Electric Fusion Weld Line Pipe. Great care is taken to be certain circumference is always constant. This permits fast, accurate line-up for high-speed girth welding. Uniform wall thickness assures an even distribution of metal all around the pipe—with no thin spots to worry about. Precision manufacturing techniques produce high ductility and yield strength, to keep maximum dependability in high-pressure service.

Republic, a leading pipe producer for more than 25 years, makes steel pipe for every oil and gas handling need. Electric Fusion Weld comes in sizes from 24″ through 30″ O.D.; Electric Resistance Weld from 2⅜″ through 16″ O.D.; and Continuous Butt Weld from ¼″ through 4″ nominal.

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The Industry This Week

• **PRODUCTION:** Amazing results are indicated from early field tests of miscible-phase displacement. Three companies have field projects under way, a fourth is to start next month, and more are expected. Recovery of up to 85 to 90 per cent of the oil is promised from these early projects. P. 96.

Better coordination between geologists and reservoir engineers may be the key to producing more oil. This was the theme of one paper presented at the A.P.I. Division of Production meeting in Dallas. P. 101.

• **PIPELINING:** Crude from Western Canada should start flowing into the Port Credit, Ont., refining area by next September. Interprovincial has awarded construction contracts to extend its system from Sarnia to Port Credit. P. 112.

El Paso Natural Gas will be able to deliver almost 3 billion cubic feet of gas daily if the FPC approves plans presented by El Paso last week. An expansion that will boost capacity 185,000,000 cu. ft. is planned. Most of the added gas would go to California market. P. 101.

• **REFINING:** El Paso Natural Gas will have a refining capacity of 22,500 bbl. daily when it completes a new refinery planned at Odessa. This 6,500-bbl. plant will work in smoothly with El Paso's petrochemical operations at Odessa. P. 100.

McMurrey Refining's custom refinery at Tyler is changing hands, but the operation will remain the same. LaGloria Oil & Gas is scheduled to buy the 22,500-bbl. refinery next month. P. 110.

Murphy Corp. may some day enter the refining business. A company official hinted last week such a move is possible following announcement the company is buying into a marketing outfit. P. 108.

• **GENERAL INTEREST:** The Middle East situation is looking brighter.

The Middle East Emergency Committee may soon go out of business as result of developments in Egypt and Syria. Just how effectively the M.E.E.C. is meeting its goal to supply Europe with oil was outlined for a Senate subcommittee last week by the man who directs the program, Jersey Standard's Stewart P. Coleman. P. 102.

Iraq Petroleum Co. is expected to have its crude system back into partial operation this week. Complete repair of the line will take weeks, but some crude should be moving toward the Mediterranean before the week is out. P. 114.

Oil companies now are waiting for the formal announcement of new-concession awards. The winning bidders put up the money for the oil lands last week. One thing certain: There'll be some new faces in Venezuelan activity before long. P. 115.

• **EXPLORATION:** Algeria's Sahara desert is looking better all the time. The latest boost to the area's oil hopes is a discovery deeper than present production. C.R.E.P.S. has reported a 30-bbl. an hour discovery from a zone between 1,500 and 2,000 ft. at Tiguentourine. P. 116.

Odds favor higher royalties for tracts off California. One of the key figures in the state legislature is driving hard for higher rates—and says if they fail this session he will push them in later sessions. P. 110.

A new test is about ready to be spudded in the southwestern portion of the Persian Gulf. The wildcat will be drilled by Abu Dhabi Marine Areas, Ltd. The site is about 80 miles off the Trucial Coast in 50 ft. of water. P. 118.

New Recovery Idea Looks Like a Champ

- **WHAT IT IS:** Miscible-phase displacement is the latest secondary-recovery method developed by the industry. The theory is simple: Sweep the reservoir with a solvent that is miscible with crude.

- **WHY IT LOOKS SO GOOD:** It's hard to believe what early tests show. Recovery of up to 85 to 90 per cent of oil in place is promised. In an Oklahoma project, Carter stepped up production from 15 to 200 bbl. daily with the new technique.

- **WHO IS USING IT:** Atlantic Refining is one of the pioneers. So are Humble, Carter, and Sun. But all companies are watching and studying the method, and several plan to field test their research.

DALLAS.—Oil-company interest is mounting fast in the industry's latest and most spectacular method of taking a secondary crop of oil.

This is the process with the big name: miscible-phase displacement.

It promises ultimate recoveries of 85 to 90 per cent—and possibly more—of the oil in place in a reservoir. This stacks up with top recoveries from most pools now of 50 to 60 per cent after thorough water or gas driving.

Essentially all the large oil-producing companies are testing or planning to test the method, either in the laboratory or in the field.

At least four projects are now active in the field. And it's likely that the number will go on up to about 9 or 10 this summer.

The three companies with field tests going now will be joined this summer by at least three others.

Engineers are solidly enthusiastic about the technical soundness of the process. It seems to open the way at last to the engineer's dream of getting most of the oil that's there.

Yet there are a few companies hanging back. They, too, think the method is sound technically. But they are afraid it might not be economic.

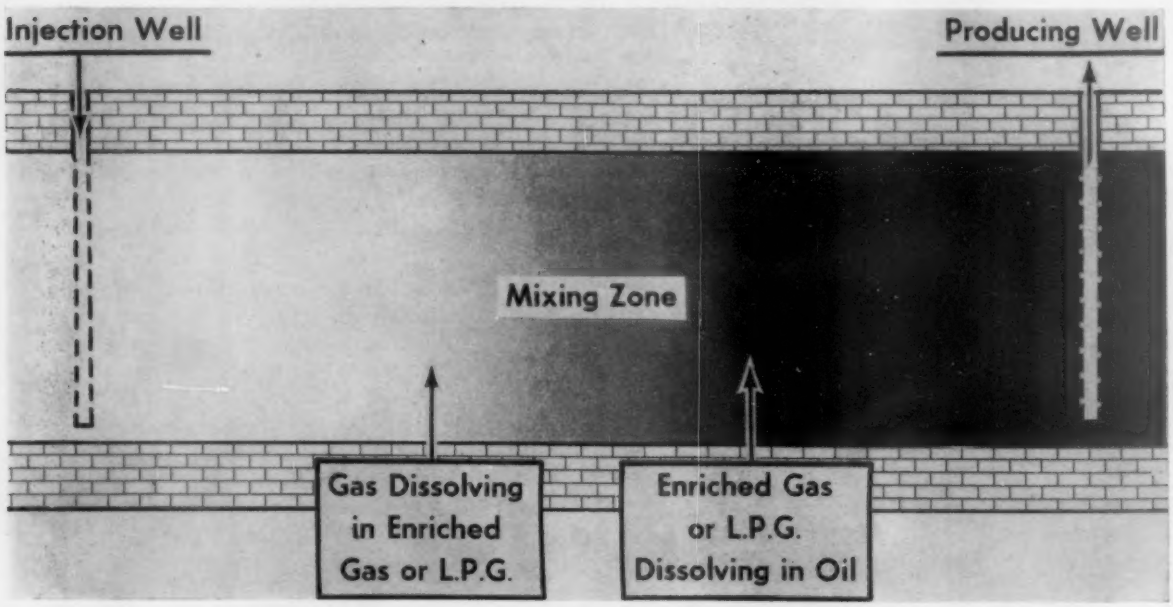
What is it? . . . Miscible-phase displacement actually is a group name taking in several new recovery methods which go different routes to do the same thing underground.

Basically, the method uses a solvent instead of water to displace crude oil. The solvent is miscible with the crude oil in the reservoir.

It has water's desirable liquid character (liquids generally make better sweeping agents than gases). Along with this, it does away with troublesome capillary effects which cut down water-flood recoveries.

In effect, the solvent absorbs crude

Here's How Miscible-Phase Displacement Works



oil out of the rock—much as kerosine washes oil out of a sponge.

You can wash the sponge once with kerosine and get all the oil out. No matter how many times you wash an oil-soaked sponge with water, some oil will always be left in the sponge.

Oil companies have been aware of the potential of so-called solvent floods (using butane or propane) for a long time. However, it just wasn't economic to fill a reservoir with solvent while displacing the oil. The fluid put in, plus the cost of putting it in, would have added up to more than the value of the crude oil taken out.

Now, using the miscible-phase principle, operators feel they can get the same results using a relatively small amount of solvent—and in certain cases none at all.

They are using these three methods:

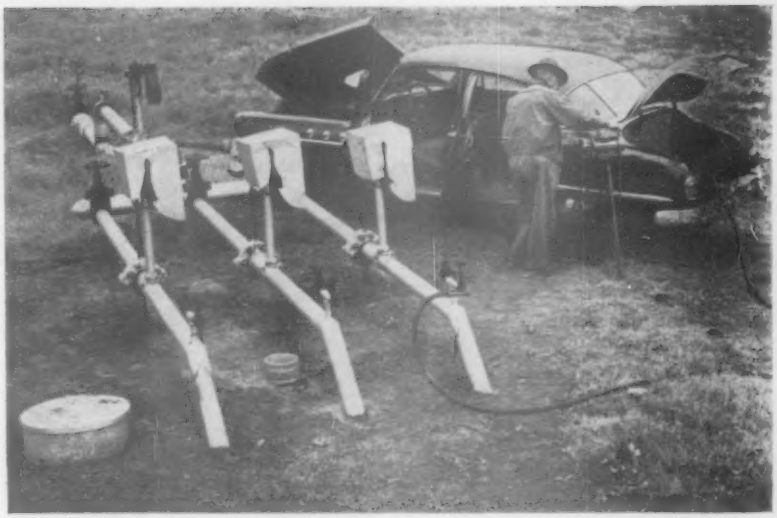
. . . **Injecting a slug** of butane and/or propane, then chasing it with dry gas.

. . . **Cycling a rich casinghead gas** or a dryer gas souped up by adding propane or butane.

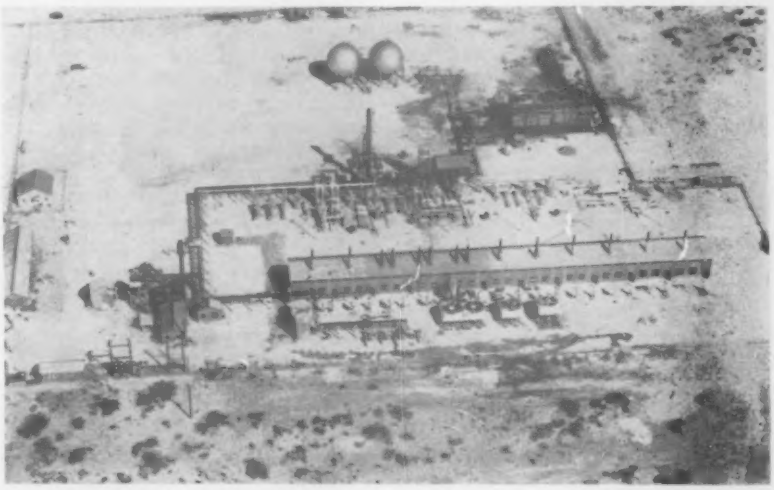
. . . **Injecting dry gas** at very high pressures.

Despite the differences in approach, all three work the same way in displacing reservoir oil.

There is no sharply defined front, such as in a water flood. There is instead a transition zone which runs the hydrocarbon gamut from dry gas to reservoir crude oil.



OUTPUT CLIMBED during field tests of Carter Oil Co.'s L.P.G. slug project in Oklahoma's Seminole County pool. The operator has recovered 120,000 bbl. of added oil since the project was kicked off on the small C-2 Block leases in 1953. Progress of the miscible front is checked (above) by frequent tests of gas production.



HIGH PRESSURE creates the miscible effect at Atlantic Refining Co.'s project in the Block 31 Devonian field of Crane County, West Texas. This program is the granddaddy of them all. It started back in 1949, and it keeps looking better every day. The plant has compressors of 9,500 hp. and injects about 37,000,000 cu. ft. of gas daily.

High-Pressure Gas Method

The pioneer company in the field is generally conceded to be Atlantic Refining Co. with its high-pressure gas injection method.

This is the method that requires no L.P.G. However, it is limited to reservoirs with high bottom-hole pressures—those with roughly 3,000 psi., or above.

Atlantic has had such a project going in Block 31 Devonian field in Crane County, West Texas, since July 1949. It keeps looking better all the time.

The project has been expanded three times and now takes in more than 6,000 acres. The company is injecting about 37,000,000 cu. ft. of gas daily through 15 input wells at a wellhead pressure of over 4,000 psi.

The reservoir MER has been kicked up from about 4,500 bbl. daily at the start to 15,350 bbl. daily now.

Atlantic figures that it already has produced about 10 per cent of the oil in place in the Devonian. With the pay zone's original solution-gas drive, this 10 per cent would be about two-thirds of the expected crude take from the field by primary depletion. Block 31 is still a young field. It was discovered in 1945.

Here Atlantic is creating the miscible effect with high pressure. Instead of injecting a solvent, it "manufactures" it in the reservoir. The high-pressure gas passes over a residual oil as it enters the pay zone and picks up light components. With this enrichment it becomes highly soluole in the virgin reservoir oil.

Moving on through the pay, the enriched gas creates a bank of swollen liquid, light in gravity and near the viscosity of the virgin reservoir oil. The swollen oil sweeps the reservoir crude to producing wells.

Atlantic so far has found no evidence of gas channeling or breakthrough. Most of Block 31 is on a uniform nine-spot injection pattern. In a few cases, producers have been drilled off pattern and are nearer input wells.

The company figures that gas will break through to these nearest producers within 2 to 4 years from now.

Last year, Atlantic kicked off a second and smaller high-pressure project in the Neale field of Beauregard Parish, Louisiana, and it is looking over several other prospective fields.

Atlantic judges that the high-pressure process is applicable to more than 5 per cent of domestic reserves. This takes into account the fact that the method, though it could be applied technically in many cases, seldom would be attractive economically in water-driven pools.

Between 10 and 15 per cent of domestic oil reservoirs, the company thinks, are deep enough to sustain the required high pressures and also have desirable crude properties. The percentage should go up as more deep production is discovered.

Atlantic was granted U. S. patents (Nos. 2,724,437 and 2,724,438) on the high-pressure method late in 1955.

Atlantic is the only firm using this method in the field.

Condensing Gas Drive

About April 1, Humble Oil & Refining Co. will begin the first field test of its new version of the miscible-displacement technique.

Humble is passing up pilot field tests and will launch full-scale projects in the Goen and Cambrian reservoirs of the big Bronte field in Coke County, West Texas.

Unitization of these two pays and the field's Palo Pinto, Capps, and Gardner zones has been completed.

As operator, Humble will gather unusually rich casinghead gas from the Palo Pinto, Capps, Goen, and Cambrian zones and inject it at 2,200 psi. in the vapor phase through five inputs into the Goen and two into the Cambrian.

Bronte gas is unusually rich, containing only 55 to 58 per cent methane.

Oil from the Goen zone will be heated to hike the volume and liquids content of the casinghead gas from that zone.

If the unit finds that the input gas needs to be still richer to maintain miscibility, it will soup it up still further with propane or some other light liquid.

In both the Goen and Cambrian floods, the unit will employ a line-drive type sweep. Input wells split both pools from east to west and will sweep from center to ends.

Gases from the various pays now reach the field gasoline plant at pressures ranging from 4 psi. to about 225 psi. Work is about 70 per cent complete on a plant to pressure the gas on up to the 2,200-psi. input pressure.

Technique varied . . . Humble, on its own, will try a variation of this technique in its wholly owned Zone 20-B reservoir in the huge Seeligson field in South Texas.

Instead of a rich casinghead as at Bronte, Humble will inject a half and half mixture of separator gas and propane. It plans to inject 35,000 to 40,000 bbl. of propane and about 50,000,000 to 55,000,000 cu. ft. of gas a month into the 6,200-ft. pay zone.

The 20-B pay has 648 developed acres with 12 wells. Crude in this reservoir is saturated whereas that in Bronte's Goen and Cambrian pools is undersaturated.

SUN'S L.P.G. SLUG in the Millican field of Coke County Texas, is unusually interesting because it involves a reef. There are good indications a fluid front is forming. Sun hopes to know within a year whether it will pay to expand the flood.

Humble wants to try the program for 2 years during which it plans to inject products worth about $1,500,000. If the test is successful, the company will expand it to other reservoirs in the field. In this event, Humble would build a major gasoline plant in the area at a cost of $20,000,000 to $30,000,000.

Spectacular recovery . . . Humble estimates that the condensing-gas-drive approach will result in takes of from 60 to 100 per cent of a reservoir's total oil in place.

At Bronte, it plans on hiking recovery from the Goen and Cambrian 50 per cent over and above what it could get through water flooding.

At Seeligson, it thinks it will hike its take to 475 per cent of that available by primary production.

The L.P.G. Slug

This is the approach which appears to be drawing the most interest so far.

Two field tests are under way. And prospects are that there will be at least four and possibly five or six operating before the end of the year.

Carter Oil Co., Pan American Petroleum Corp. (formerly Stanolind), Atlantic, Gulf Oil Corp., and Sun Oil Co. have pioneered on this version.

Pan American, Atlantic, Carter, and Gulf are reported to have applied for patents.

It calls for injecting a carefully calculated volume of L.P.G. and chasing the slug with gas.

Carter Oil is elated over results of its first field test of the method on its C-2 Block leases in Seminole County pool, Oklahoma. It is considering more and larger projects.

Oil production rates at C-2 Block during the test climbed from 15 bbl. daily to about 200 bbl. daily. The rate throughout the test averaged out nine times higher.

From this small lease, Carter figures it has recovered roughly 120,000 bbl. of added oil since the project was started in 1953. The company injected 143,000 bbl. of propane and followed it with 325,000,000 cu. ft. of gas. As of last October, it had reproduced more than a third of the propane.

The average gas-oil ratio still is below the pretest figure.

A reef test . . . Sun Oil Co. is beginning to get returns from a similar project launched last summer in the Millican Reef field of Coke County, Texas.

This field, wholly owned by Sun, takes in 37 wells and 1,480 acres. It produces from the Strawn reef at about 6,000 ft.

Sun previously had been carrying out a conventional gas-injection program in the field. The pilot slug test is limited to the northern nose of the field. Gas injection is continuing to the south (see map).

The company finished injecting 600,000 gal. of propane-butane mix—85 per cent propane—through one input well last September. It now is injecting 2,500,000 cu. ft. of gas daily through this well. Another 3,500,000 cu. ft. daily is being pumped into the Strawn through the original gas input a location to the south.

Further south is another input well for the conventional gas injection in the rest of the field. The input rate in this well is running about 14,000,000 cu. ft. daily.

Gas for injection is produced-gas stripped of compression liquids only and is fairly rich.

Tests on offset producers in the pilot area are showing decided cuts in producing gas-oil ratios. Sun regards this as a good indicator that a fluid front or transition zone is forming.

Producing rates of the offsets have been controlled tightly since one of them is a marginal well. So the company can't yet see higher oil output. It believes though that output would go up quickly if controls were removed.

Sun thinks it will know within a year just how successful the test will be. If results are good enough, it likely will expand the pilot.

The Sun project is of unusual interest because it involves a reef. Such pays generally are unpredictable and harder to figure than sands or limestones.

The Millican Reef crude is a light oil grading about 46° gravity. It was saturated at the original pool pressure of 2,534 psi. Gas-oil ratio was 1,300:1. Pressure in the pilot area averaged about 1,575 psi. in March 1955. It has been built up now to about 1,700 psi. and will be maintained at about that level.

Others coming . . . The Carter and Sun tests are the only slug tests now going. But others will be popping up soon.

Atlantic is flanging up plans to kick off a project in a South Texas field It is looking over two other prospective pools in Louisiana.

Atlantic's plans for field tests follow exhaustive lab work which yielded highly favorable results. Using very long sand columns engineers got yields with the slug method of 95 per cent of oil in place. Yield hikes over a very favorable gas drive figured out to 11 bbl. of stock tank oil per barrel of propane injected.

Sunray Mid-Continent Oil Co. also plans to start a propane-butane slug test within 6 months. Sunray will bypass lab work, feeling that it can learn more by going directly to the field.

Firms which had concentrated hard on thermal recovery methods are also becoming keenly interested in the slug method. Both Magnolia Petroleum Co. and Sinclair Oil & Gas Co. have started research.

Application of Economics

Generally, the high-pressure process is feasible only for the deeper, high-pressure reservoirs. The L.P.G.-slug and condensing-gas-drive versions are aimed primarily at the shallower pools with lower bottom-hole pressures.

None of the three approaches at this stage is a magic new method to be applied anywhere. Whether a pool will qualify as a good prospect for a miscible-type drive depends on:

. . . Reservoir condition. Pool pressure is important. So are sweep efficiencies. Engineers think that uniformity of the rock should have a bearing. Reservoir temperature must be considered.

. . . Nature of the crude oil. Like fingerprints, no two crudes are exactly alike. Selection of the flushing agent for the slug method depends a great deal on the type of oil in the reservoir. The oil might even lack certain components which would bar formation of a miscible front.

Engineers think it best for the oil to be light and undersaturated. The heavier the oil, the more intermediates needed—and the less economical a project would become.

In pools with asphaltic-base crudes, propane likely would precipitate out asphalt. This might cut down permeability and hurt recovery.

Of all these reservoir and crude-oil factors, pressure is the only one which can be varied—and this only within reason.

Payout doubted . . . Even if a reservoir should appear ideal as a miscible-drive prospect, there may be reasons why such a project wouldn't be economically sound.

Pools with active water drives, for instance, likely will not be considered, at least not in the near future.

The operator has to consider the cost of the gas or L.P.G. or both. He must weigh higher cost of a miscible drive and its higher recovery against a not-so-fruitful water flood at a lower cost.

Though a solvent drive will displace essentially 100 per cent of the oil from the area it sweeps, there will be portions of the reservoir it won't touch. The same is true of all other sweeping agents.

As a matter of fact, water has a better mobility ratio as a sweeping agent than L.P.G. This means that, though L.P.G. will recover much more oil from the area swept, water will sweep the bigger area.

One of the country's largest producers thinks the economic obstacles to this type of secondary recovery are too big. Technically, the company is enthusiastic about the process. But it says it has found no field yet where it could apply a miscible drive and figure a payout.

Items of cost . . . The operator mentions these extra expense items which must be considered:

. . . Cost of L.P.G. at the plants.

. . . Cost of transporting it to the field by pipeline or truck.

. . . Cost of injection equipment.

. . . Cost and difficulty of getting the L.P.G. out after it has displaced the oil.

. . . The long wait before recovering the L.P.G.—with the capital tied up for years.

. . . The high cost of gas if gas is used behind the L.P.G. or the cost and difficulty of cleaning the pay of L.P.G. if the miscible drive is followed by a water flood.

This company feels that the price of crude would have to go up considerably in relation to the prices of both L.P.G. and gas before the method could be applied generally.

Bright outlook . . . This viewpoint, however, appears now to be in the minority.

Operators now testing or about to test the method admit that these questions on cost are valid. But they feel that a miscible drive can be practical. And that operators can and will come out well in the black if they chose their projects wisely.

At least one operator now in the field plans to follow up its miscible drive with a water flood—convinced that it will be economical.

Projects now under way or soon to start will shed some light on the economic angle.

No operator enthusiastic about miscible-phase displacement thinks that the new method will make obsolete present water-flood and gas-drive recovery methods.

They do feel, though, that the process will prove a valuable new tool in oil's recovery kit. It can be a highly versatile tool. There are no technical reasons why it wouldn't work either after or before a pool has been gas driven or water flooded.

They concede that demand for natural gas and L.P.G. may get so heavy and the price so high that these products definitely couldn't be used to recover crude oil.

But they point out that time and know-how will introduce other liquids and fluids, some not even hydrocarbons—for use as sweeping agents.

One thing is certain. The next few years will see more and more field tests, with more and more operators getting into it.

Some firms already are convinced the method is practical from all standpoints. Others think it is. And those who doubt the economics likely won't be willing to fall too far behind—just in case.

New Journal Pipeline Maps Off the Presses

Accompanying this issue is possibly the finest set of wall maps The Oil and Gas Journal has ever published. Size is 42 by 56 in. These multicolor maps are printed on both sides.

On one side, routes of all U. S. and Canadian natural-gas pipeline systems are shown. The other side covers products and crude pipeline systems. Line sizes, compressor stations, and company headquarters are given. Extra copies of this map can be ordered from:

Reader Service Department
The Oil and Gas Journal
Box 1260
Tulsa 1, Okla.

New Refinery Planned

● El Paso Natural's refining capacity will hit 22,500 bbl. daily when 6,500-bbl. Odessa plant goes on stream

ODESSA, Tex.—El Paso Natural Gas Co. has taken another big jump toward its goal of becoming a large refiner and marketer of oil products.

Its processing subsidiary, El Paso Natural Gas Products Co., will soon start building a brand new 6,500-bbl. refinery and alkylation plant on the southeastern edge of Odessa *(The Oil and Gas Journal, February 18, page 1)*.

The new plant will go up on a site just south of the butadiene and styrene plants the firm is now building as part of a huge synthetic-rubber complex.

Its facilities will include crude, vacuum, catalytic cracking, gas concentration, Platforming, and HF alkylation units.

The new refinery will be in a highly favorable position to keep on top of the octane race. Crude oil is plentiful near Odessa. Along with this, the plant will get a steady flow (about 2,000 bbl. daily) of high-octane raw material — butylene, isobutane, and propylene—as byproducts from the butadiene and styrene plants. The refinery will convert these to alkylate for blending into premium automotive and aviation fuels.

It will also produce regular gasoline, kerosine, diesel fuel, and fuel oil.

Contracts have been let to Universal Oil Products Co. for process design and to Fish Engineering Co. for engineering and procurement of major equipment.

The plant is slated to go into operation early next year.

Products line, too . . . El Paso Natural Gas Products at the same time will build a 240-mile, 6-in. products line from the refinery to El Paso and a storage terminal at the El Paso end.

The products will be marketed from this terminal throughout West Texas, New Mexico, and Arizona. Both the line and terminal will be completed by early 1958 when the refinery is placed on stream.

The products line is being designed by Pipeline Engineering Co., Dallas.

The line had been planned for more than a year. Originally, the plan was to build an alkylation plant somewhere along its route between Odessa and El Paso. The line would have fed natural gasoline and L.P.G. from West Texas into the plant. A second plant at El Paso was initially planned to blend the alkylate with motor gasoline from the company's nearby refinery at Brickland, N. M. *(The Oil and Gas Journal, September 3, 1956, page 72.)*

Capacity going up fast . . . With completion of the new Odessa plant, El Paso will have gone in little more than 2 years from a nonrefiner to a company with five refineries and a total processing capacity of about 22,500 bbl. daily.

In October 1955, the company bought out McNutt Oil & Refining Co. of El Paso to get into the refining business. The purchase netted it the 3,200-bbl. refinery at Brickland, seven terminals, 125 retail outlets, and a lot of processing know-how in McNutt Oil & Refining technicians.

It has since bought two more small plants at Prewitt and Bloomfield, N. M., from Malco Refineries, Inc. All three purchased plants have been revamped and expanded.

Last fall it started building its first new refinery at Ciniza about 17 miles east of Gallup in northwestern New Mexico. This modern plant, which like the Odessa refinery will have a crude-charge capacity of 6,500-bbl. daily, will go on stream this fall.

The Ciniza plant is a near twin to that at Odessa. It also will have crude distillation, vacuum, catalytic cracking, alkylation, and Platforming units.

BIG EL PASO DRIVE for refining capacity will give it 22,500 bbl. daily with completion of newly announced Odessa plant. El Paso got into the refining business in October 1955 with purchase of McNutt plant (above) at Brickland, N. M.

Oil Pricing Probed

Federal grand jury begins with sales-department quiz

ALEXANDRIA, Va. — Pricing practices of major oil companies came under scrutiny of a federal grand jury here last week.

More than a score of witnesses from company sales departments were called as the jury began its catch-all inquiry which may cover many phases of industry activities before it is ended.

After hearing the first group, the probe will be recessed while a new batch of witnesses is rounded up.

The jury has a broad order to find out whether there have been violations of the antitrust laws in the production, distribution, storage, or sale of oil and products.

But "you are to make any other inquiry you feel should be made," Judge Albert V. Bryan instructed.

Judge Bryan cautioned the jurors against returning an indictment based only on "suspicion." An indictment is very serious for the accused because of the "grave stigma, embarrassment, anxiety, and expense" incurred, he said.

"Evidence must be of such weight that, if uncontradicted and unexplained, would cause a trial jury to convict," the court warned.

The first witnesses called included employes and executives from the Atlantic, Continental, and Sun oil companies. A number of other companies also are listed for investigation.

Teamwork points one way toward . . .

How to Get More Oil

DALLAS.—The alarming climb in oil-finding costs has operators scratching hard for ways to get more oil from fields already found.

They're working to do this by hiking operating efficiency and perfecting new secondary-recovery methods.

But oil managements are missing one good bet.

They have largely failed to see that they could gain a lot more oil by better coordinating and even integrating their geological and reservoir-engineering efforts.

This oversight was pointed out last week by Norman J. Clark and Arthur J. Wessely of Core Laboratories, Inc., Dallas. Their paper was delivered here at the annual spring meeting of the southwestern district of the A.P.I. Division of Production.

Problems and solutions . . . Every oil operator has three basic problems.

The first is to find the oil or gas pool.

The second is to decide if it can be produced at a profit and if so to develop it.

The third is to produce it in such a way as to insure maximum return on the investment.

The geologist and the reservoir engineer, the authors say, need to work much more closely together in solving all three of these problems.

Finding an oil pool is basically the geologist's job. But the reservoir engineer can be of great help in interpreting data gleaned from examination of samples and cores, core analysis, log studies, and from drill-stem and production tests.

The second problem—that of deciding if a pool is commercial and exploiting it—concerns the geologist and reservoir engineer equally.

An operator should decide as soon after a discovery as possible whether the find is good enough to justify more drilling. This first estimate of the commercial value of the pool should be based, according to Clark and Wessely, on: (1) knowledge of the regional geology, and (2) engineering estimate of the oil or gas reserve developed by each well.

The geologist-engineer team comes up with better figures on net rock volume, oil or gas in place, and the portion recoverable.

Better well-completion and spacing programs result when the specialists work together. Costs are cut in that some well workovers and recompletions can be avoided later in the production stage. The unnecessary producers aren't drilled.

Actual production of the pool later on in the best way possible is primarily the reservoir engineer's problem. But, the authors said, his engineering studies in this respect are only as good as the geological and other data on which they are founded.

El Paso to Expand

New pipeline facilities will cost $107,000,000

WASHINGTON. — El Paso Natural Gas Co. has outlined the final phase of an expansion program which will raise capacity to almost three billion cubic feet daily.

The Federal Power Commission has received El Paso's plans to spend $107,100,000 to increase deliveries 185,000,000 cu. ft. daily. This is part of a program started last year to expand El Paso capacity more than 750,000,000 cu. ft. daily.

The new application requests authority to sell 75,000,000 cu. ft. daily to Southern California Gas Co. and Southern Counties Gas Co., Los Angeles; 75,000,000 cu. ft. daily to Pacific Gas & Electric Co., San Francisco; and 35,000,000 cu. ft. daily to Arizona customers.

El Paso will build 216 miles of trunk line, 533 miles of gathering line, and 86,750 hp. in compression to move the additional gas from Texas and New Mexico.

The company recently received FPC approval for an $84,500,000 program to increase deliveries to the California companies by 150,000,000 cu. ft. daily. This amount would be divided equally between the Los Angeles and San Francisco utilities. Southern Counties and Southern California are building 241 miles of 30-in. loop along their Newhall, Calif.-Topock, Ariz., line to take the additional gas. P. G. & E. is completing the 34-in. looping of its Milpitas-Topock line.

El Paso will wind up a $196,000,000 expansion next month, including 338 miles of 34-in. loops and 56,990 hp. in compressor capacity. This will boost deliveries 450,000,000 cu. ft. daily.

The portion of the program which will get under way soon will involve some 406 miles of large-diameter pipeline. The timetable calls for completing 81 miles of 18-in. in July, 74 miles of 34-in. in August, and 176 miles of 20-in. and 74 miles of 30-in. by next January. Contracts are still to be let.

Import Figures Due

Flemming asks importers for reports by March 22

WASHINGTON. — Importing companies have until March 22 to file new oil-imports schedules. Mobilizer Director Arthur S. Flemming said the schedules should cover the first 6 months following reopening of the Suez Canal.

"The Government is under obligation to resume consideration of this matter as soon as the situation in the Middle East permits a return to normal oil movements in international trade," Flemming said in a letter to importing companies.

"When this information is received from your company, as well as from the other oil-importing companies, it will put the Government in a position where it can best determine what your and the other companies must do in order to maintain the desirable relationship between oil imports and domestic production."

He warned that in making this determination, "the Government will not be bound by the pattern of distribution which has developed during the present emergency."

Sinclair Talks are Recessed

KANSAS CITY, Mo.—Wage talks between Sinclair Oil Corp. and the Oil, Chemical, and Atomic Workers International Union are recessed indefinitely, "subject to call by either party."

Sinclair rejected demands for a 27-cent-an-hour increase, and offered no counter proposal at a brief formal conference which ended here earlier this month.

Company officials said the talks were on a very high level and discussion of all issues was objective and free of ill feeling on both sides.

This is O.C.A.W.'s second reject from Sinclair since the big 105,000-member union outlined the 1957 wage demands last December. O.C.A.W.'s Sinclair contract, which expires June 15, is the union's only nationwide contract. It involves more than 10,000 Sinclair employes.

The best offer to O.C.A.W. so far came from Standard Oil Co. (Ind.). and Socony Mobil Oil Co., Inc. These companies offered a 3 per cent increase (or about 8 cents an hour)—far short of the 27 cents demanded by O.C.A.W.

JERSEY'S Stewart Coleman explains how the oil-lift was handled.

Oil's Critics Answered

Coleman counters O'Mahoney plea for federal control by saying Government couldn't do what oil men have done

WASHINGTON.—Rerouting tankers after closing the Suez Canal saved Europe from a shortage of 1,000,000 bbl. of oil daily this winter.

Striking back at charge of mishandling of the Suez crisis, Stewart P Coleman, chairman of the Middle East Emergency Committee, told Senate probers last week that Europe will get 83 per cent of her normal requirements of motor gasoline, distillate, and residual fuels this quarter. Needs for aviation gasoline and jet fuel, ships bunkers, and lubricating oil are being met in full.

Even better coverage of Europe's needs is expected in the second quarter, Coleman said.

Charges that the M.E.E.C. companies dictate the handling of the oil lift were met head-on by Coleman. The committee can do no more than gather data, make estimates and submit recommendations to the Government, and carry out government orders, he said.

Coleman also explained that the M.E.E.C.:

... **Has no power over** domestic production.

... **Cannot and has not** allocated supplies.

... **Has no authority** to operate a tanker pool or any other pooling arrangement.

... **Can neither buy** or sell oil.

... **Can deal with domestic** operations only to the limited extent of actions with the U. S. by participants in the plan under government-issued schedules.

... **Takes no action** and makes no recommendations on prices of crude or products, tanker rates, or financial aspects of any actions by anybody.

"The principles and procedures used by the M.E.E.C. to meet successfully this emergency are not new," Coleman said. "They formed the basis for coordinated oil industry efforts to meet the needs of the U. S. and its allies in World War II and the Korean war."

Coleman's appearance marked the start of the last phase of the subcommittee's probe, already running through 5 weeks. He was called, with M. J. Rathbone, president of Standard Oil Co. (N. J.), to give the M.E.E.C.'s answer to the charges made against it. Coleman is a Jersey Standard vice president.

O'Mahoney favors controls . . . Coleman was questioned at length regarding his activities in the Petroleum Administration for War and on the Foreign Petroleum Supply Committee of which the M.E.E.C. is a part.

Sen. Joseph C. O'Mahoney of Wyoming, chairman of the subcommittee, was especially interested in the changes made last year in the voluntary foreign petroleum supply agreement. These included the naming of a government official as chairman of the committee and a ban on any member seeing the supply and requirements figures of any other member.

O'Mahoney asked Coleman if there was any reason these safeguards should not apply to the M.E.E.C. But Coleman pointed out that if they had been it would have been necessary to set up a big government staff to analyze the figures and suggest ways of meeting Europe's needs. And no such body could work out the ingenious ways of meeting problems that oil men with the facts before them could.

The M.E.E.C. members don't want to see the information, but must have it to do their job quickly and well, he said.

"Even if you had the best talent in the industry working for the Government, it wouldn't be nearly as effective," he told O'Mahoney.

Coleman disclosed that it was not the oil companies but the Government that asked for a waiver of the restrictions in the foreign supply agreement.

O'Mahoney refused to concede that the M.E.E.C. needed a free hand. There is no reason why Congress can't set up a plan as it wants it, he said.

Imports enter hearing . . . Coleman also outlined the domestic import situation during his appearance before the subcommittee.

Imports have been cut about as far as they can go, Stewart P. Coleman, chairman of the Middle East Emergency Committee, said. Imports from the Middle East are now down to 9,000 bbl. daily. All is going to the

Oil-Lift Plan to Taper Off

WASHINGTON.—M.E.E.C. activities soon will be curtailed, and the entire program will be halted as soon as the need is past.

Recent developments make it look as if the emergency is nearing an end, Asst. Interior Sec. Felix Wormser told the National Petroleum Council last week. The developments are Egypt's agreement to open the Suez Canal and Syria's announcement it will permit repair of Iraq Petroleum Co.'s crude oil lines.

Some oil may be moving through both the canal and the pipelines this month, Wormser said.

First step in shutting down M.E.E.C. would be the closing out of schedules for pooling tankers. The committee would continue to gather information in order to keep abreast of Europe's need for building its stocks and to determine the amount of oil needed from the U. S.

Gulf Coast—"coals to Newcastle," he told the committee.

Imports from Venezuela, 805,000 bbl. daily in January, will be down to 750,000 bbl. a day this month. Factors of quality, continuity of supply and coastwise shipping laws will limit further cuts.

Neely attacks Humphrey . . . The O'Mahoney subcommittee will go further into this subject if Sen. Matthew M. Neely of West Virginia can force it. Neely questioned Coleman at length on the theme that Treasury Secretary George M. Humphrey has a big interest in the M. A. Hanna Co., which in turn holds some $22,000,000 worth of stock in Standard Oil Co. (N. J.) and an interest in Seaboard Oil Co.

Neely said Humphrey is "the most influential member of the National Security Council," which sets national policies. He also speaks for the President on financial matters.

Humphrey's indirect interest in oil puts him in a "Dr. Jeckyll and Mr. Hyde" role, Neely said.

Tankers are key . . . Coleman's explanation that the rerouting of tankers was the key to the whole effort to relieve Europe brought a suggestion from O'Mahoney that the Government should control this, "in light of the fact that nobody knows what may happen in the next 12 months."

O'Mahoney said that the President's Middle East plan indicates that the present situation may run for 3 years. And skyrocketing tanker rates may keep on going up, he suggested.

"Since it is in the interest of the Government that the cost of government be kept down and since Admiral Lattu (head of the Military Petroleum Supply Agency) testified that the increases that have taken place already will add $84,700,000 a year to cost of the Government for oil, don't you think it might be wise for Congress to think of regulating the activities involving the means of transporting this oil during the emergency?" O'Mahoney asked.

"All of us recognize that government controls are only justified by emergency needs," Coleman replied. "I would be very reluctant to advocate that all tankers be controlled. You cannot control one segment of the oil industry without controlling all."

Such control, however, could be effective only if all nations which register tankers agreed, Coleman explained. But Russia and Egypt are parties to the international-tanker agreement, he said, and have intimated there is little chance they would agree to register their ships.

"This is a job we were asked to do and we are doing it to the best of our ability," Coleman said.

watching WASHINGTON

. . . with Bertram F. Linz

The price of controls . . .

FINDING a workable formula for fixing gas producers' prices is one of the most serious problems facing the Federal Power Commission.

But Chairman Jerome K. Kuykendall told the House commerce committee he has another problem almost as serious. The FPC must find a way of getting and keeping enough of a staff to handle its great workload with reasonable promptness.

The committee called Kuykendall to "brief" its new members on the duties and work of the FPC. Kuykendall offered no recommendations for changes in the gas act beyond those sent to Congress last month *(The Oil and Gas Journal, February 25, page 92).*

Chairman Oren Harris of Arkansas urged Kuykendall to submit bills to carry out the FPC's ideas for changing the law. He will sponsor them in the House, Harris said.

Kuykendall agreed, in response to questions, that the whole problem of gas control could be dealt with by outright exemption of producers. But he said he doubted that Congress would pass such a bill.

If Congress will not vote exemption, the only practical solution is to spell out the FPC's powers in detail. This should include a clause barring the use of cost as a basis for rates, Kuykendall said.

Oil lift keeping up steam . . .

EUROPE'S need for heating oil will begin to taper off soon. But the need for large volumes of U. S. crude will continue for weeks, officials here say.

The oil lift may have to run in high gear into the summer to provide crude for Europe's refineries and residual fuel for its industries. Just how long will depend on the Suez Canal. Today the canal appears no nearer opening than it did a month ago.

The petroleum emergency group of the Organization for European Economic Cooperation met in Paris last week to figure out second-quarter supply and consumption. It is expected to report that, except for distillates, there will be no lessening of dependence on Western Hemisphere supplies.

Even if normal transit from the Middle East resumes within the next 2 to 3 months, experts say, the need for U. S. oil will continue until Europe's badly depleted stocks are rebuilt.

State regulation questioned . . .

A CASE which some oil men believe will decide the fate of state regulation is expected to reach the U. S. Supreme Court soon.

It is Gulf Oil Corp.'s challenge of an order issued last year by the Oklahoma Corporation Commission. Under that order all common purchasers were required to take all oil offered them up to the allowable of each lease.

Gulf claims that the order making a company take oil for which it has no market creates an unreasonable burden on interstate commerce. The order would restrain production in other states or invite them to adopt similar laws, the company said.

A series of legal moves have paved the way for getting the case before the highest court.

While buyers fight orders to take more oil than they want, Oklahoma producers complain about the low allowables set by the state. The amount of oil over which Gulf is fighting is only 5,500 bbl. a day. Producers ask: If that restrains interstate trade, how about the hundreds of thousands of barrels of foreign oil imported daily?

Producers are watching the Gulf case closely. If the Supreme Court upholds the company it will be the end of state regulation and the start of chaos in the industry, they say.

Senate joint subcommittee investigating oil prices is just one example of . . .*

How Committees Affect the Oil Industry

Bertram F. Linz
Washington Editor

WASHINGTON.—The 2-month-old Eighty-fifth Congress has settled down to its 2-year job of making new laws. It has set up its committees and given them money to work with, and most of the President's legislative program is before it.

The committees have the task of sifting the thousands of bills that are introduced. They decide what measures shall be taken up. They hold public hearings on these. If finally the committee approves a bill, it goes to the House or Senate floor for vote.

So far this year, 7,500 measures have been introduced. By the end of the Congress next year the total will be around 20,000. Less than 2,000 of these can be expected to be enacted. And nearly half of these will be private bills for the relief of individuals or organizations.

Oil will be a major subject of the Eighty-fifth Congress. Five bills affecting oil and gas already have been written, and many more are expected.

There are 19 standing committees in the Senate. The House has 19. More than half of these committees deal with oil and natural gas one way or another. These are the committees which the industry should watch for signs of laws to come. They include:

. . . Interstate and foreign commerce committees, House and Senate. Probably no other committees can have greater influence on the oil industry. Their assignment includes the adequacy of oil and gas resources for defense and the needs of an expanding economy; development of synthetic liquid fuel processes; and regulation of natural gas.

Rep. Oren Harris of Arkansas heads the House group. Two years ago he sponsored the bill to exempt independent gas producers from federal control which was vetoed by President Eisenhower in 1956. Last month his committee held a series of hearings on the European oil lift and price increases.

Sen. Warren H. Magnuson of Washington is chairman of the Senate group. He has set up a subcommittee under Sen. John O. Pastore of Rhode Island to make a full study of various oil matters, including pipelines and tankers.

Due to be taken up this year is a new bill to lift federal control from gas producers. But a number of other subjects have been laid before these committees. These include the setting up a commission to regulate the oil industry and the writing of safety regulations for interstate gas pipelines.

. . . Judiciary committees, House and Senate. They handle all matters of monopoly and antitrust law.

This year, again, they have bills both to override and to sustain the Supreme Court decision in the Standard Oil Co. (Ind.) "Detroit" case. The Senate group will hold hearings this month on the question of "good faith" as a defense against charges of price discrimination when lower prices are offered a customer to meet competition.

The Senate committee, headed by Sen. James O. Eastland of Mississippi, also is engaged in a probe of the European oil lift and oil-price increases.

Outstanding members are Sens. Joseph C. O'Mahoney of Wyoming, chairman of the antitrust and monopoly subcommittee which, with a public lands subcommittee, is making that investigation; Estes Kefauver of Tennessee, who is sitting in on the inquiry and who also wrote the "good faith" bill; and Matthew M. Neely of West Virginia, a leader in the fight for quotas on oil imports.

Rep. Emanuel Celler of New York is chairman of the House group. He is a bitter opponent of "big business" and champion of the small businessman.

. . . House ways and means committee. All money bills must start here. Taxes and tariffs are important subjects of this group.

This year it is expected to provide the arena in which a battle to reduce

*IN PHOTO: Clockwise from Sen. Kefauver are Sen. Neely, Sen. Wiley, Committee Counsel Don McHugh. Sen. O'Mahoney, the committee clerk, Standard of New Jersey's S. P. Coleman, M.E.E.C. Counsel Fowler Hamilton, Jersey President M. J. Rathbone, and Jersey's associate general counsel, N. J. Campbell.

the industry's depletion allowance will be staged. Any new fight to get quotas on oil imports also will be held here. Rep. Jere Cooper of Tennessee is chairman of the committee.

The Senate finance committee, which plays the same part in the upper chamber, is headed by Sen. Harry F. Byrd of Virginia.

... Banking and currency committees, House and Senate. These deal with economic stabilization, mobilization matters under the Defense Production Act. The House committee has a bill to set up a system of emergency fuel allocations, but is not expected to take it up. Rep. Brent Spence of Kentucky and Sen. J. W. Fulbright of Arkansas are chairmen.

... Armed services committees, House and Senate. They watch over the activities of the military services, including the handling of the naval petroleum and shale reserves. They also have been interested in plans for defense pipelines to the East and West coasts.

This year the committees expect to get requests from the Navy to let it explore for a possible new reserve on San Nicolas Island off the California coast and to start new shale-oil research at the former Bureau of Mines plant at Rifle, Colo.

Rep. Carl Vinson of Georgia is chairman of the House committee. He knows more about the Navy than any other man in Congress. And he always has kept a sharp watch over the naval oil reserves. Sen. Richard R. Russell, also of Georgia, heads the Senate group.

... Interior and insular affairs committees, House and Senate. These deal, among other things, with such matters as mineral leasing and use of oil and gas resources on the public lands and outer Continental Shelf.

The House committee is especially interested in the Defense Department's attempt to have large areas on the Continental Shelf reserved for military use, barring oil development. Rep. Clair Engle of California, chairman, is backing a bill to require congressional approval of any withdrawals exceeding 5,000 acres. Sen. James E. Murray of Montana heads the Senate committee.

... House merchant marine and fisheries committee. This has charge of all shipping legislation, including programs to encourage the building of new tankers. It has before it a bill to set up a floating weather station in the Gulf of Mexico to protect offshore operators. Rep. Herbert C. Bonner of North Carolina is chairman.

... Public works committees, House and Senate. These committees are in charge of measures for river and harbor improvement, regulation of navigation, and control of water pollution. Rep. Tom Murray of Tennessee and Sen. Dennis Chavez of New Mexico are chairmen.

... Appropriations committees, House and Senate. These groups pass on all appropriations. They have control of the funds granted for the oil and gas activities of the Interior Department, Federal Power Commission, and other agencies. They also fix the amounts to be spent on any government program, such as foreign aid.

Rep. Clarence Cannon of Missouri heads the House committee. He wields a sharp paring knife on departmental desires. Last month his group chopped $60,000,000 out of the Interior Department's requests. Sen. Carl Hayden of Arizona heads the Senate committee.

... House labor and public welfare committee. This group handles all matters relating to labor, including the Taft-Hartley Labor Relations Act, the minimum wage law and the Walsh-Healey government contracts law. Rep. Lister Hill of Alabama is chairman.

The same field is covered in the Senate by the committee on education and labor, headed by Sen. Graham A. Barden of North Carolina.

... Small business committees, House and Senate. These are "select" committees. Unlike the standing committees, they cannot initiate or pass on legislation. Their purpose is to study the problems of small and independent business. Rep. Wright Patman of Texas and Sen. John J. Sparkman of Alabama are chairmen.

Quiet and beauty turn the tide:

Los Angeles Bows to Oil Search

LOS ANGELES.—Chalk up another win for California operators pioneering in the field of soundproof, landscaped drill sites.

Nearly 500 acres of high-priced residential and recreational property in West Los Angeles will soon be under exploration.

The path was cleared for drilling this highly promising acreage after property owners withdrew their objections when assured operators would soundproof rigs and beautify their drill sites.

The Los Angeles City Planning Commission then approved setting up a drilling district on the 180-acre Rancho Golf Course as the first official step toward actual exploration.

The City Council's Planning Committee also voted unanimously to set up additional drilling zones around the course. These include:

... 120 acres covering some 35 blocks immediately west of the 20th Century Fox movie lot.

... 144 acres of privately owned Hillcrest Country Club. Signal Oil & Gas Co. has leased this acreage.

... Approximately 40 acres of residential property northeast of Hillcrest and east of the movie lot. Signal also has this under contract. The company will explore the acreage by slant-drilling from the Hillcrest Country Club.

All of this property immediately offsets 20th Century Fox's movie lot where Universal-Consolidated Oil Co. has been slant-drilling high producing wells for 3 years. Universal now has 11 wells on the lot flowing 3,000 bbl. daily under restrictive chokes. These wells were drilled from a single soundproofed, landscaped site.

Other areas . . . At least three other areas in densely populated parts of the city are currently seeing leasing plays. In these areas, as at the West Los Angeles activity, operators are staking their hopes for securing drill sites on the reputation of soundproofed operations.

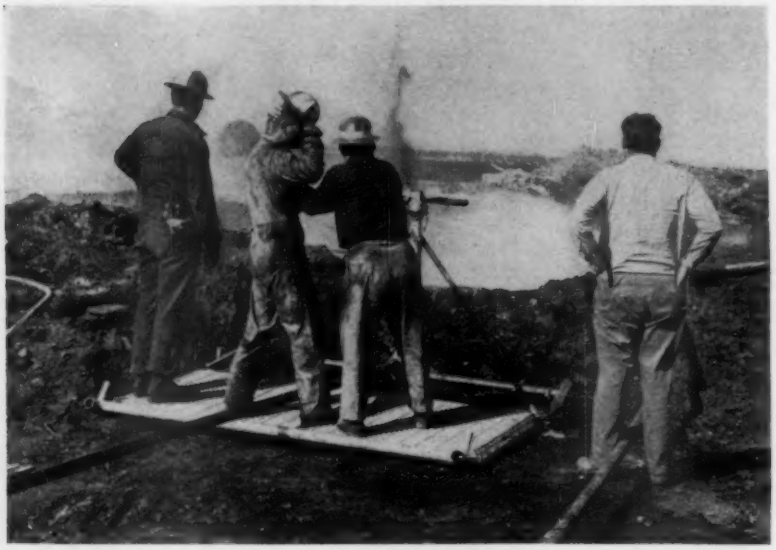
Union Oil Co., Signal, and Guiberson & Burke are currently competing for leases on several hundred acres of the southwest side of downtown Los Angeles. This area, all highly developed residential property, contains an explored, highly regarded topographical high.

Guiberson & Burke is a newly formed company. Principals are Allen Guiberson of Dallas and E. G. Burke, Jr., of San Antonio. Guiberson is an independent producer and former oil-tool company owner. His oil-tool firm was recently sold to Dresser Industries, Inc. Burke was formerly active in Texas' Scurry field.

Richfield Oil Corp. is pacing a leasing play in the Silverlake district about 3 miles west of the city hall in another residential area.

Morgan Brown, Beverly Hills oil producer, was getting ready to drill on a 43-acre parcel on the site of old Salt Lake field along Los Angeles' restaurant row on La Cienga Boulevard. This acreage is on the west edge of a leasing flurry now under way along fashionable Wilshire Boulevard.

Firemen Move in for Kill as . . .



. . . Well Makes Flaming Debut

ABILENE, Tex. — J. H. Darden 1 looks like a good well. But it started off on the wrong foot.

Located near Throckmorton, about 60 miles northeast of here, the well was bottomed at 4,770 ft. in the Mississippian when flames broke out to shoot an estimated 150 ft. into the air. It blazed 53 hours before firefighters from Myron M. Kinley Co. of Houston doused the flames with chemicals last week

Four workers were burned but none seriously.

A rotary rig and drilling and testing equipment valued at about $215,000 were destroyed. D. L. Rose Drilling Co. of Albany owned the rig. The well was being drilled for Grisham-Hunter Corp. of Abilene.

Before the fire, Darden 1 flowed oil from 7 of 14 drill-stem tests. It got 75 bbl. in the Mississippian, the highest for any one zone. The oil which was burning came from an open-hole section at 4,482 to 4,770 ft. Gas also was burning. Oil continued to flow after the fire was out. The well was later capped.

Industry briefs

Twenty-inch pipe is rolling off the assembly line at Canada's first big-inch pipe mill at Welland, Ont.

Welland Tubes, Ltd., started production at its new $10,000,000 plant with an order for 150 miles of pipe for Interprovincial Pipe Line Co.'s extension from Sarnia to Port Credit, Ont.

When this is completed — probably by the end of May—production will begin on a multimillion-dollar order for Trans-Canada Pipe Lines, Ltd., which is building a gas line from Alberta to eastern Canada.

The Welland plant is a joint project of Page Hersey Tubes & Steel Co. of Canada, Ltd. It is capable of turning out 20 to 36-in. steel pipe. Annual capacity is 200,000 to 300,000 net tons.

Tennessee Gas Transmission Co. has increased its oil production in Kansas by nearly 35 per cent through buying various assets of Midstates Oil Corp.

Tennessee Gas paid the Tulsa-based company $1,900,000 for all of its producing properties, undeveloped leases, and nonproducing royalties and mineral interests in Kansas. Widespread reports of the purchase were confirmed by Ralph C. Graham, T.G.T. senior vice president.

The purchase included 54 oil wells on 2,280 producing acres and about 83,000 acres of undeveloped leases. The property is scattered through 38 counties in central and western Kansas.

Through the purchase, T.G.T. added 800 bbl. of oil to its average net daily production. Its daily average oil production in Kansas is now 3,100 bbl.

Humble Oil & Refining Co. and Pure Oil Co. have sold about 5,000 acres of producing and semiproved acreage in Huxley gas field of Shelby County, East Texas, to Shreveport investors headed by Charles McCord, Jr.

McCord of McCord Oil Co. said the payment was about $1,000,000. Most of the acreage was owned by Humble. The Shreveport group gets four producing gas units in Huxley with reserves in the 6,500-ft. Pettet lime estimated at between 30 and 40 billion cubic feet.

Three more tankers were given necessity certificates last week. Listed for rapid writeoff by Office of Defense Mobilization were two 32,500-ton vessels now under consideration by Nautilus Shipping Corp., New York. Each certificate, issued to the affiliated Nautilus Oil Carriers Corp. and Nautilus Petroleum Carriers, granted rapid writeoff of 40 per cent of $11,500,000.

The third tanker, now under construction by Newport News Shipbuilding & Dry Dock Co. for National Trans-

port Corp., will be a 60,000-tonner. It will cost $18,000,000 and 40 per cent of this cost was earmarked for rapid amortization.

Lion Oil Co. will move its exploration and production headquarters from El Dorado, Ark., to Houston within 2 or 3 months. T. M. Martin, president, pointed out that Houston is a more convenient base for the company's foreign operations in Central and South America. He said it also "presents greater opportunity for entering into offshore drilling in the gulf."

A proposal to create an oil and gas conservation commission in Nebraska has been killed by the legislature's judiciary committee. A similar bill died in the 1955 session. This year's measure was postponed indefinitely, an action reserved for unwanted legislation, by a 4-3 vote of the committee. The bill would have provided for appointment of a commission to supervise the production of oil and gas at maximum efficient rate.

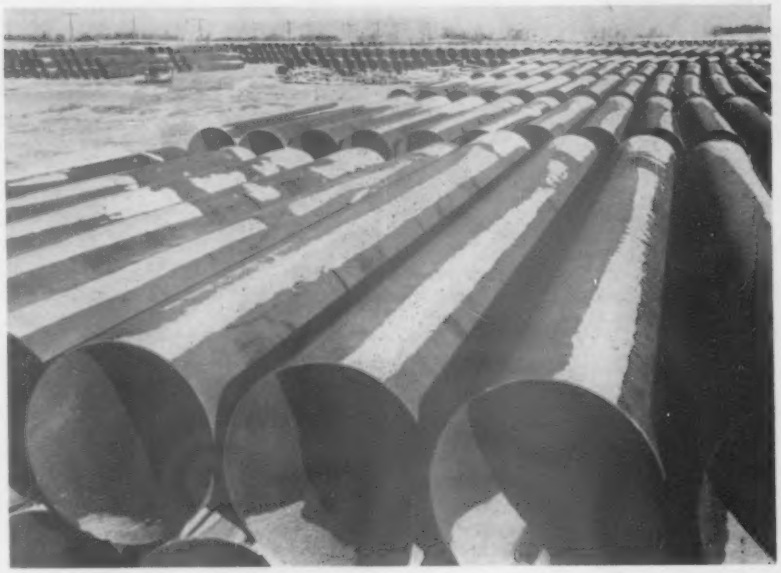
A Navy T-2 tanker blew up in Delaware Bay last week and sank almost immediately after a midnight collision with a Liberian freighter. First reports were that the freighter struck the Mission San Francisco midships and sparks ignited fumes from the empty cargo tanks.

The center section of the 503-ft. tanker exploded in a blast that was felt in Philadelphia. The vessel was operated for Military Sea Transport Service by Mathiasen Tanker Industries, Inc. Eight of the civilian crew were missing.

The half-cent increase in federal gasoline tax, imposed last July 1 to help pay for the highway program, is showing up in tax collections. In the last 6 months of 1956 collections totaled $693,255,000. They were $539,328,000 in the same 1955 period. The diesel fuel tax, increased at the same time, brought in $16,682,000 against $12,257,000.

Part of the increase was due to higher sales, however. This was indicated by the revenue from lubricating oils, $45,649,000 against $39,229,000, and pipeline transportation, $18,289,000 against $16,532,000.

Alberta's oil production for 1956 totaled 143,909,641 bbl. with a gross value of $355,173,842, according to the Petroleum and Natural Gas Conservation Board. This was a jump of 30 million barrels over 1955 and 60 million barrels over 1954.



Stockpiles are tipoff:

Trans-Canada Ready for Spring

CALGARY.—Weather is all that is holding up full-scale construction on Canada's big natural-gas line from Alberta to Toronto.

Trans-Canada Pipe Lines, Ltd., expects six spreads to be at work on the line this summer. One of the spreads will be on the northern Ontario section to be built by a crown corporation.

Stockpiles such as the one above are ready and waiting to be laid as early this spring as weather permits. This one, at Rapid City, Manitoba, contains 20 miles of 34-in. pipe in 40-ft. sections. The sections will be double jointed into 80-ft. lengths and strung along the right-of-way.

Finishing touches are being put on clearing and grading work along spreads three, four, and five. Contractors on these sections are Dutton-Williams Brothers; Mannix, Ltd.; and Poole-Price Construction.

Canadian Bechtel, Ltd., contractor for spread six, has started clearing and grading operations. This spread will take the line to a point 5 miles east of Winnipeg.

There has been no announcement on the contractor for spread seven, which will handle the section from Winnipeg to the Ontario border. All these sections are set for completion this year.

Spreads one and two in Alberta were completed last year. They covered 230 miles of the 574-mile leg from Alberta to Winnipeg. The line is scheduled to reach Winnipeg by August or September.

River crossings . . . Marine Pipeline & Dredging of Vancouver is nearing completion on two river crossings, one at Portage La Prairie and the other at Miniota. A double-jointing yard is being set up by Canadian Bechtel at Portage La Prairie.

Ottawa officials have announced that at least one crew will be at work this summer on the northern Ontario section. Right-of-way has been surveyed. The section will be financed by the federal and Ontario governments and leased to Trans-Canada, which will have an option to purchase.

The entire line will stretch 2,250 miles across Canada. Trans-Canada hopes that 1,300 miles of it will be laid by the end of 1957.

Stock demand high . . . Stocks being offered by Trans-Canada's gathering system—Alberta Gas Trunkline, Ltd.—are far short of demand. Bidders in Alberta applied for 14,115,776 shares. But there were only 2,552,320 shares to be distributed in the province.

Government sources say this means a maximum allotment of 20 shares per applicant. It will be several weeks before certificates are issued. If there are any left over at that time, they will be alloted to bidders.

Total public offering of Trans-Canada stock and debentures amounts to $112,500,000. Canadians will get $81,250,000 worth of the offering, with the remaining $31,250,000 worth going to U. S. Buyers *(The Oil and Gas Journal, February 11, page 72).*

ODM Hot Seat Changing Hands

WASHINGTON.—The Office of Defense Mobilization is getting a new top hand. And taking over its tough oil problems is a man whose views on oil are unknown to the industry.

There are a number of parallels between incoming Mobilization Director Gordon Gray and outgoing Director Arthur S. Flemming. Both are in the young group brought into the Government by President Eisenhower (Gray is 47). Both held important jobs under former President Truman. Both have been university presidents.

Unlike Flemming, however, Gray's service previous to taking over the ODM did not bring him into close contact with the oil industry. And Gray is one of the most silent men in the Government today.

Although he was a newspaper publisher, he doesn't like to meet reporters and he shies away from publicity. His record contains little which would give a clue to his ideas on imports or other oil problems.

GORDON GRAY
. . . his views a mystery to oil.

Policy maker . . . The job of mobilization director carries with it a post on the National Security Council. The NSC is a top policy-making group. Thus Gray will be one of the top men in the administration.

Gray, therefore, will play a strong role in the handling of oil problems. His advice to the NSC will aid it in reaching decisions. As head of the ODM, he then will have the job of putting those decisions into effect.

Gray has a reputation for clear thinking and thoroughness. So he may be expected to spend several weeks in studying such questions as oil imports before deciding where to go from where Flemming leaves off.

The only hint of Gray's stand on imports is to be found in a report on economic policy he wrote for President Truman in 1950. That report supported expansion of foreign trade. Inferentially it disfavored import quotas. But the present administration holds much the same views on this subject as did Truman. Its opposition to quotas led to the passage of the national security clause in the Trade Agreements bill, paving the way for the "voluntary" controls which didn't work out.

Since it expresses administration policy, Gray is expected to take the same view of imports that Flemming held. But Flemming was ready only a few months ago to urge the President to do something to limit imports which he admitted had reached a point where they threatened national security. The big question is how Gray will handle the very tricky problem.

Background . . . Gray, who might be called a combination psychologist and lawyer, should be well prepared for his new job. He received a B.A. degree in psychology from the University of North Carolina and an LL.B. degree from the Yale University Law School. He was termed a "dazzling" student at both places.

He once appeared headed for a career with the R. J. Reynolds Tobacco Co., where his father was president and board chairman until his death in 1935. He went so far as to work in several tobacco sorting houses with the company "to learn the business from the ground up" before switching to law.

Gray later purchased controlling interest in the Piedmont Publishing Co. of Winston-Salem, N. C., and built the company's two daily newspapers and radio station from second-rate operations into politically influential operations. He gave up control of the company and resigned as its president when he entered government service.

Gray, who served in the Army during World War II and rose from private to captain, was brought into the Government by Truman in 1947 as assistant secretary of the Army. Two years later he was named secretary. He resigned in 1950 to become president of the University of North Carolina.

He was appointed assistant secretary of defense by Eisenhower in 1955. From that post he is switching to the ODM.

Gray was born in Baltimore May 30, 1909, but has lived in North Carolina some 20 years. A former practicing attorney, he was a member of the North Carolina Senate from 1939 to 1942, when he resigned to enlist in the Army.

As new mobilization director, Gray has one of the biggest jobs and some of the toughest decisions in Government ahead of him. But from all indications, he isn't worried about it. A former Pentagon associate once had this to say about him:

"He's got one hobby—work. He gets here at 7:30 in the morning . . . Works every Saturady and most Sundays."

Murphy Expands

Production and exploration firm buys marketing outfit

EL DORADO, Ark.—Murphy Corp. has taken a step toward becoming an integrated oil company, with acquisition of the majority interest in River States Oil Co.

River States is an independent marketing firm operating in Illinois, Iowa, Minnesota, and Wisconsin. It is principally a wholesaler for independent stations, but it also markets under the name of "North Star" through its own service stations.

Murphy Corp. produces crude in the Southwest, the Rocky Mountains, and in Canada. Recently it developed production in the Gulf of Mexico through a subsidiary, Ocean Drilling & Exploration Co.

Chief asset of River States is a large marine terminal on the Mississippi River at LaCrosse, Wis. Headquarters are in Evanston, Ill. Myron Holmgren will continue as president and general manager.

A Murphy official said that although the company has no immediate plans for a refinery, it my ultimately decide to enter that field, too.

Executives Purchase Stock

CALGARY.—The two top executives of Trans-Canada Pipe Line Co., Ltd., have exercised options to buy a total of 105,000 shares of common stock in the company at $8 a share, $2 a share below the nominal value of the stock when it went on the market.

N. E. Tanner, president, bought 55,000 shares at the $8 price and C. S. Coates, vice president and general manager, bought 50,000 shares. The purchases were revealed in the recently released prospectus of the company.

Coates is a former executive of Tennessee Gas Transmission Co. It is un-

derstood the option offer to Coates was arranged to give him a tax-free supplement to his $45,000-a-year salary.

Tanner's salary is $35,000 a year. He may retain his post as president at least until March 9, 1959, if he wishes to do so. If he retires, he will receive an allowance of $15,000 a year for 5 years.

Octanes Finally Slip

Ethyl survey shows slight drop in February averages

THE long-continuing climb of octane numbers was interrupted in February, according to the monthly Ethyl Corp. survey.

National weighted averages for premium and regular grades were 97.3 and 90.4, respectively, both down 0.1 from January. Compared with a year ago, premium was up 0.9 octane number in February and regular was up 1.2 octane numbers.

The spread of 99-plus octane was also arrested in February. But one supplier is now marketing this grade in 20 of the 53 cities tested and another is marketing it in 7 cities. Octanes over 100 showed up agan in February, with the same supplier offering 100.6 in Baltimore and 101.3 in Houston.

PREMIUM
(Cities per octane group)

Group—	Feb. 1957	Jan. 1957	Feb. 1956
90-90.9	0	0	0
91-91.9	0	0	0
92-92.9	0	0	2
93-93.9	0	0	3
94-94.9	4	4	7
95-95.9	1	0	13
96-96.9	18	17	12
97-97.9	18	21	16
98-98.9	12	11	0
Total cities	53	53	53
Wtd. avg. RON	97.3	97.4	96.4
Wtd. avg. TEL ml./gal.	2.47	2.47	....

REGULAR
(Cities per octane group)

Group—	Feb. 1957	Jan. 1957	Feb. 1956
81-81.9	0	0	0
82-82.9	0	0	1
83-83.9	1	1	0
84-84.9	0	0	1
85-85.9	1	1	6
86-86.9	7	6	12
87-87.9	4	5	2
88-88.9	7	7	6
89-89.9	13	13	10
90-90.0	3	3	6
91-91.9	9	8	9
92-92.9	8	9	0
Total cities	53	53	53
Wtd. avg. RON	90.4	90.5	89.2
Wtd. avg. TEL ml./gal.	2.02	1.97	....

Pipeline briefs

Pioneer Gathering System, Inc., will purchase residue gas from a Sinclair Oil & Gas Co. plant in Hulldale field, Schleicher County, Texas, starting July 1. Pioneer has contracted to take 12,000,000 cu. ft. daily at first. Sinclair is installing sweetening and dehydration facilities to condition the gas for pipeline. Pioneer will build a compressor station near the Hulldale plant.

Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y., plans to build a 46-mile, 10-in. gas line from Albany to Kingston, N. Y., this year. The project is to be completed by November 1. It will make additional gas supplies available to the Central Hudson Gas & Electric system.

Westspur Pipe Line Co., which is operating almost at its 42,000-bbl. daily capacity, plans to loop 75 miles of the 109-mile, 12-in. crude line in southeastern Saskatchewan. The loop will be 16 in. in diameter. Construction will start in May and be finished by July 3. Westspur delivers into the Interprovincial pipeline at Cromer, Man.

Marine Pipeline & Dredging, Ltd., is constructing river crossings for three big crude and gas-line projects in western Canada. It will complete 30-in. crossings of Red and Assiniboine rivers for Trans-Canada Pipe Lines, Ltd., this spring, the last to be finished by May 31. A 30-in. crossing of the Thompson River in British Columbia will be completed for Trans Mountain Oil Pipe Line Co. June 15.

Marine Pipeline & Dredging also is building bridge crossings at the Peace and Fraser rivers for Westcoast Transmission Co., Ltd. The latter projects are joint ventures with Marwell Construction, Ltd., and Iroquois Construction, Ltd.

Union Gas Co. of Canada, Ltd., plans a 142-mile, 26-in. transmission line in Ontario from its Dawn storage to Hamilton this year. The company plans 55 miles of branch lines of 6 to 20-in. to supply new markets, mostly between London and Hamilton. Union will start in May on 317 miles of distribution lines from 2 to 12-in. Completion of the whole program depends on pipe delivery.

Union is building up markets in advance of the arrival of large volumes of Alberta gas through Trans-Canada pipeline. It is now supplied by Panhandle Eastern Pipe Line Co. from the United States, its own wells in southwestern Ontario, and from other Ontario producers.

Hood Construction Co., Whittier, Calif., will wind up two projects early this spring. A 28-mile, 12-in. gas line for Pacific Gas & Electric Co., from Hinkley to Victorville, Calif., to serve two cement plants, will be completed April 1. Hood will complete a 300-mile 2 to 10-in. distribution system in Boise, Idaho, by April 31. This project is for Fish Service & Management Co.

Northern Natural Gas Co. plans to spend $63 million this year to expand service to existing customers and enter new markets. Plans to be laid before the Federal Power Commission call for adding more than 200 new communities to the Northern Natural system. Last year the company spent $54 million raising capacity to 1,196,000,000 cu. ft. daily, an increase of 66,000,000 cu. ft., and bringing service to 28 new towns and cities.

Also for Pipeliners . . .

El Paso Natural has laid plans before the FPC that will boost the system's capacity to almost 3 billion cubic feet daily (P. 101) . . . Weather is all that is holding up a busy construction season for Trans-Canada pipeline (P. 107) . . . Tennessee Gas Transmission has joined that elite circle of companies with assets topping $1 billion (P. 111) . . . Interprovincial has awarded contracts for extending its crude system from Sarnia to Port Credit, Ont. (P. 112) . . . Transcontinental Gas Pipe Line will spend $61,500,000 to expand capacity 111,400,000 cu. ft. daily if the FPC approves plans for the expansion (P. 113) . . . Crude should start flowing to the Mediterranean through Iraq Petroleum Co. lines this week. Syria has agreed to permit the damaged lines to be repaired (P. 114).

PLUS THESE TECHNICAL FEATURES: The Journal's annual natural gas and natural-gas pipeline issue starts on page 119.

Odds in California say:

Offshore Rates Going Up

SACRAMENTO, Calif.—Behind-the-scenes jockeying on proposed changes in California's offshore royalty rates resumed last week when the State Legislature reconvened here.

Odds favor the group pushing for changes, according to legislative observers. The primary reason is that legislators are gun-shy about siding with the oil industry since the voters overwhelmingly rejected the Conservation Act in the last election.

Two key figures on the legislative scene have introduced amendments calling for changes. One is Allen Miller, assemblyman and chairman of the powerful Assembly Rules Committee. The other is Joseph Shell, assemblyman and one of the authors of the Cunningham-Shell Act of 1955. It was this bill that opened up 135 miles of previously withheld offshore acreage to exploration and development.

Miller flatly predicted in Los Angeles recently the royalty rates would be changed.

One of his amendments to the Cunningham-Shell Act would group wildcat acreage with proved acreage and provide a sliding-scale rate beginning at 12½ per cent. Under present law, wildcat acreage goes for a flat 12½ per cent and proved acreage for a sliding-scale rate beginning at 16⅔ per cent.

Assemblyman Shell has introduced two amendments to his tidelands law which would affect royalty rates. They would:

. . . Give the State Lands Commission discretion to lease wildcat acreage at either the present flat 12½ per cent scale or on a sliding-scale rate.

. . . Lump wildcat and proved acreage under a sliding scale beginning at 16⅔ per cent.

Miller said recently he is convinced that under the present royalty provisions, the state will not realize its maximum gain from offshore oil. He does not feel, as many contend, that a sliding scale on all leases would lower bonus bids substantially.

It was just a month ago that a Miller-sponsored resolution was unanimously passed by both houses of the state legislature calling on the State Lands Commission to hold up leasing until the state had a chance to review the act. This move delays any more leasing for at least a year.

Felix Chappellet, vice president of the Western Oil and Gas Association, charged in Los Angeles last week that Miller's resolution halting leasing followed issuance of a "clouded" subcommittee report authored by Miller.

Chappellet asked that the ban be lifted immediately and that the Cunningham-Shell Act be kept intact.

"It showed a complete lack of knowledge of the distinction between different kinds of potential oil lands . . .," Chappellet said of Miller's report. "The ommission of basic facts has led Mr. Miller and his subcommittee into the absurd assumption that within a few geological reports, an oil company can tell without fail where an oil field is and how much it will produce."

Boycott threat . . . Olen Lane, vice president of the W.O.G.A. and vice president and regional manager for Continental Oil Co., said recently:

"If such amendments go into law, many of the big oil companies won't even bother with the tidelands, but will invest their money in areas where the economic climate is sounder.

"The costs of offshore wildcatting are already so high that such undertakings are made with great risk. We're not even sure there is a profitable tidelands field worth the gamble."

In an interview, Miller said he is not too concerned with the industry's threat to boycott offshore bonus bidding if royalty rates are increased. At the same time he said he was not adverse to seeing the state go into the oil business in the event of an industry boycott. But he said that would be only as a last resort.

Miller said he based his optimistic outlook on the potential of the tidelands on the oil industry's own testimony before his and other legislative committees. Several responsible California oil men have repeatedly estimated California's offshore reserves at between 2 and 4 billion barrels, he said.

Lane took issue with the 4 billion barrel estimate. He insisted the estimate is high.

Lane labeled onshore prospects in California as "very dim" and said that unless offshore exploration is encountered and made available economically, California's oil industry would find itself in a state of liquidation. Rather than increase rates, Lane proposed they be made more liberal.

In answer to industry claims that offshore exploration is already almost prohibitively expensive and a tremendous gamble. Miller cited a recent bid of $7,250,000 for a 5,500-acre parcel off Santa Barbara as evidence of the higher regard operators have for the state's tidelands.

Odds favor change . . . When asked what chances he felt the several measures now in the hopper calling for royalty changes had in passing, Miller said:

"I think there is enough sentiment in the legislature, and public interest, to indicate a favorable climate for changing royalty provisions."

And if they are not changed at the current session, Miller said, he will continue to push for such changes at subsequent sessions.

Custom Plant Sold

LaGloria buys 22,500-bbl. McMurrey plant at Tyler

TYLER, Tex.—LaGloria Oil & Gas Co. is flanging up a deal to buy McMurrey Refining Co.'s highly versatile custom refinery here.

The 22,500-bbl. plant will give the Corpus Christi firm a much more integrated look. LaGloria is now primarily a producer and natural-gas processor.

When the deal is closed in early April, LaGloria will acquire all stock in the refining company as well as McMurrey Pipeline Co. The latter includes 25 miles of main crude line and gathering systems in East Texas.

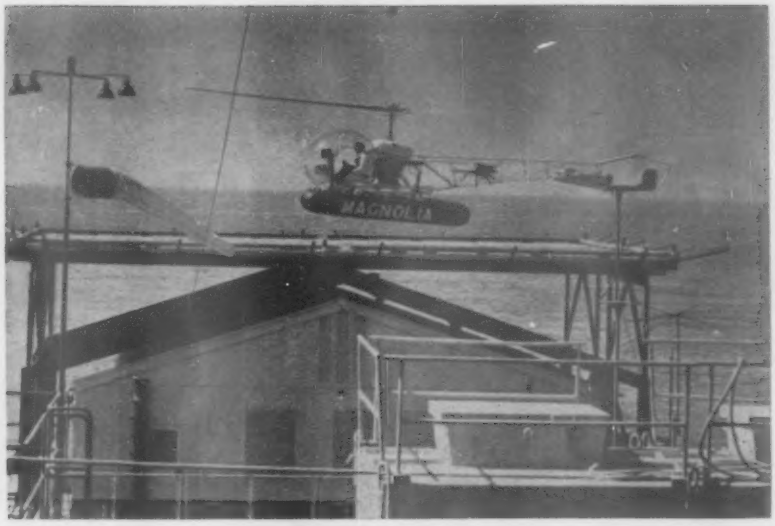
The Tyler refinery, which is recognized for its modern refining methods, manufactures premium motor fuels, aviation gasoline, kerosine, diesel fuel, petroleum coke, and certain specialty products.

LaGloria does not expect to engage in retail marketing and will continue the same policy of custom refining as the McMurrey company.

LaGloria operations . . . The firm now produces about 6,000 to 7,000 bbl. of oil daily, and 8,500 bbl. of plant products per day. It also produces 90 million cubic feet of gas daily, and processes more than 300 million cubic feet.

A major expansion program at LaGloria's plant in Texas will increase gasoline, kerosine, and L.P.G. products to more than 10,000 bbl. daily. Thus, LaGloria production just about equals capacity of the McMurrey refinery.

The company also owns a 25 per cent interest in Great Southern Chemical Corp. of Corpus Christi. It manufactures benzene, toluene, and zylene.



With a "helihomer" at the helm . . .

Copter Outsmarts Gulf Storms

DALLAS.—Magnolia Petroleum Co.'s Gulf Coast whirlybird has acquired a homing instinct.

It sports a new navigational device which guides it in bad weather quickly and directly to the company's offshore rigs.

Before this, fog or rain over the Gulf was a big hazard. It was easy to miss the rig, and a helicopter can't carry much fuel.

The instrument, called the "Helihomer," is the first designed for copters.

The complete system includes a radio transmitter on the rig and a receiver in the helicopter. The copter picks up an ulta-high frequency signal from the rig and "rides" it directly to the landing platform.

The equipment was designed, built and tested by Clover Field Radio Supply Co. Magnolia's chief pilot, Sam Willis, persuaded the radio firm to develop a guiding device for helicopters working up to 50 miles offshore.

Magnolia's helicopter operating out of Beaumont, Tex., was used for all tests. And the oil company bought and installed the first unit produced.

Magnolia thinks the equipment also might be used to guide crew and supply boats in the Gulf or as an aid in offshore survey work.

T.G.T. Joins $1-Billion Circle

HOUSTON.—Tennessee Gas Transmission Co. has joined the elite group of companies with more than $1 billion in assets.

After only 12 years of operation, T.G.T. has grown into one of the 40 largest companies in the United States.

Consolidated assets of Tennessee Gas and its subsidiary companies totaled $1,006,562,455 at the end of 1956. The total a year earlier was $868,-018,179. Chief factor in boosting assets during 1956 was a $106,000,000 expansion of the company's natural-gas pipeline system. The main line extends from the Texas-Louisiana Gulf Coast to the Appalachian and northeastern states.

In his annual report to stockholders, President Gardiner Symonds pointed out that net income in 1956 reached a peak of $34,702,871. This is 14 per cent greater than the 1955 net.

Gas deliveries through the T.G.T. system in 1956 climbed to 638,923,248 M.c.f., 18 per cent above the previous year.

The company set a record last December 26 when, for the first time, it delivered more than 2 billion cubic feet of gas in a single day. The record was short-lived, however. During January the company delivered an average of more than 2 billion cubic feet daily.

Pipelines, production . . . Total pipeline mileage of T.G.T. was increased to 9,811 in 1956. Average-day pipeline delivery capacity rose to 1,863,000 M.c.f. and peak-day delivery capacity increased to 2,080,000 M.c.f.

Applications now pending before the Federal Power Commission would permit further expansion to 2,400,000 M.c.f. average-day capacity and 2,800-000 M.c.f. on peak days. The proposed expansion would cost about $184,000,-000.

Tennessee Gas closed the year with 1,793 net producing oil and gas wells. Daily average production of oil, condensate, and plant products rose 29 per cent during the year to 26,650 bbl. (See related story on page 264).

In his letter to stockholders, Symonds forecast "still further expansion and diversification" for T.G.T.

"Much progress and advancement lie ahead for the natural-gas industry," he stated, "and it is the intention of your company to share substantially in the future growth of gas transmission and the related handling of oil and gas hydrocarbons."

Sooner Test Finaled

State's deepest producer flows gas and condensate

OKLAHOMA CITY.—British-American Oil Producing Co. has filed potential on Oklahoma's deepest producer.

The company's 1 Reed in Grady County was completed flowing gas and condensate from the second and third Bromide sands through perforations at 15,220-15,330 ft. and 15,575-15,635 ft.

Flow during potential test was at the rate of 9,400,000 cu. ft. of gas daily with 160 bbl. of 56.5°-gravity condensate per M.M.c.f. Shut-in tubing pressure after 19 hours was 5,982 psi.

The well is in Knox field in the southern part of the county. It is a mile north of B.A.'s deep Bromide discovery, the 2 Harrison, which it displaced as the deepest producing well in the state.

The 2 Harrison was completed flowing gas and condensate in February 1956 from open hole at 15,250-15,310 ft. The 1 Reed was drilled to 15,772 ft. and plugged back to 15,714 ft. Operator set 5½-in. casing at 15,748 ft.

British-American has three other confirmation wells now drilling. The 1 Kriger, about 2½ miles southeast of the discovery, is down to 13,801 ft. The 1 Teter, 2 miles northwest of the 2 Harrison, last week had reached 2,008 ft. And the B-1 Harrison, 1 mile east of the discovery, was down to 3,923 ft.

A NEW PREMIUM gasoline—Atlantic Imperial—is now on sale at 8,000 Atlantic Refining Co. outlets. Here, D. T. Colley (left), Atlantic vice president and general manager of marketing, helps Philadelphia Dealer Joe Hartnett, dress up a pump island with the new Imperial insignia.

Atlantic Sticks to Two Grades

PHILADELPHIA. — Atlantic Refining Co. is sticking to its two-grade policy by putting a brand-new beefed-up premium gasoline on the market.

The new Atlantic Imperial went on sale through 8,000 dealers last week. It replaces the old premium and sells for 4 cents higher than regular.

Company officials said they are sticking to two grades after 2 years of research and field analysis.

"The facts that emerged from this study were quite simple and compelling. We can (with two grades) serve the maximum requirements of all cars on the road today without adding complications for the consumer or expense for our dealers and distributors."

Atlantic's premium pumps are identified by red, white, and blue colors with a bright gold shield.

Improved performance of Atlantic Imperial is attributed to a "special" additive.

Crude-Line Extension Is Let

TORONTO. — Interprovincial Pipe Line Co. has awarded contracts to Somerville Construction Co. of Toronto and Majestic Contractors, Ltd., Edmonton, to extend its crude system from Sarnia to nearby Port Credit, Ont.

Somerville will build the first 90 miles of 156-mile, 20-in. line. Majestic will build the remaining 66 miles. Construction will start this spring. Crude from Western Canada should start flowing through the 1,939-mile system into Port Credit by September.

Capacity to Port Credit will be 111,000 bbl. per day with a single station at Sarnia. A second station could raise it to 186,000 bbl. per day.

Toronto market grows . . . The $11-million extension will permit Western Canada crude to take over a fast-growing market which is now served partially by imports from Venezuela, Colombia, and Trinidad. Expansions and planned new plants also will increase the demand for Canadian crude.

The Toronto area has a refining capacity of 35,000 bbl. daily, with 21,500 bbl. at British American Oil Co.'s Clarkson plant and 14,000 bbl. at Regent Refining, Ltd.'s, Port Credit plant. Regent will complete a 6,000-bbl. expansion this spring. British American will increase its crude capacity 40,000 bbl. by late this year.

Cities Service Oil Co. has announced at 20,000-bbl. refinery to be completed late in 1958. And Shell Oil Co. has purchased a tract at Port Credit, reportedly for a 40,000-50,000-bbl. refinery.

Looping . . . An $8-million looping program and increased horsepower will give Interprovincial the additional capacity to serve Port Credit. Loops are to be completed by August 31.

Fulton-Banister, Ltd., is laying 32.6 miles of 24-in. between Kendal and Peebles, Sask. This will complete the loop on the Regina, Sask.-Cromer, Man., section. The U. S. part of the project is 78.7 miles of 26-in. between Clearbrook, Minn., and Superior, Wis., let to R. H. Fulton & Co. It will be handled in three sections, completing the loop between Clearbrook and Superior.

Pumping stations will be built between Indian River and Gold City, Mich., and between Edmonton and Regina.

Oil Rights Voided

Court rules time runs out for "lease" idle 68 years

FRANKFORT, Ky. — The mineral rights on a tract of land in Kentucky apparently died of old age shortly before oil was discovered on the land.

A final ruling by the Kentucky Court of Appeals upheld a decision which returned 68-year-old mineral rights to a western Kentucky landowner—after the defendant had planned a drilling program which later brought in oil on the property.

The case was S. W. Bardhill vs. A. R. Sellers. Mineral rights on the Sellers property were acquired 68 years ago by a company which went out of business 2 years later.

Heirs of P. E. Hampton, who purchased the mineral rights at public auction, recently sold three-fourths of the rights to Bardhill. After the sale, Sellers filed suit in Webster Circuit Court to quiet title to leaseholding and mineral rights.

Bardhill contended the mineral holdings of the old corporation constituted oil leases. Judge Faust Y. Simpson agreed, but ruled the leases had remained idle so long they no longer could be considered valid.

Bardhill appealed the case, then drilled on the property and discovered oil. Last December the high court upheld the Webster court decision and this month denied a rehearing.

Presumably the ruling opens the way for scores of other property owners in four western Kentucky counties to reclaim mineral rights which had been sold to the defunct company and later acquired by Hampton.

Transco Sets Goal

Capacity increase of 111.4 million cubic feet planned

HOUSTON. — Transcontinental Gas Pipe Line Corp. has revealed how it will spend well over half the $113,000,000 it has earmarked for construction this year.

In an application filed with the Federal Power Commission, Transco asked for a certificate to construct $61,500,000 worth of facilities which would add 111,400,000 cu. ft. daily capacity to the company's system. Construction would include:

...Seven new compressor stations totaling 81,820 hp. and compressor engines totaling 36,940 hp. at nine existing stations. The new stations are planned for Louisiana, Mississippi, Alabama, Georgia, and North Carolina, and two for Virginia.

...About 230 miles of gathering laterals to bring new gas reserves from Texas Railroad District 1 into the Transco system. Five new gathering meter stations and five dehydration stations would be included.

...About 42 miles of 36-in. and 16 miles of 30-in. mainline looping.

Most of Transco's looping program, a $50.9-million project including 350 miles of line in nine states, has just received final FPC approval. About half the increased capacity will be to supply the Carolina tidewater region *(The Oil and Gas Journal, December 31, 1956, page 99)*. The proposal had been contested by Trans-Carolina Pipeline Corp. of Raleigh, N. C.

What increase means . . . Transco recently signed a contract to move 25,600,000 cu. ft. of gas daily from Louisiana fields for Virginia Electric & Power Co. During winter months the movement will be curtailed and equivalent volumes will be used to provide "peaking service" for Transco's distribution companies.

Six Transco customers in the New York-New Jersey-Philadelphia metropolitan area will get an additional 44 million cubic feet daily; Columbia Gas System will get 25 million for delivery in Maryland; Eastern Shore Natural Gas Co., a new customer, will get 9 million; and two companies serving the North Carolina-South Carolina Piedmont will get 4.6 million.

Transco's building program for 1957 will add about 215 million cubic feet of daily capacity, bringing the total to around 945 million cubic feet. An additional 136 million cubic feet daily is already available from storage areas for emergency distribution to the New York-New Jersey-Philadelphia area.

Processing briefs

Texas Natural Gasoline Corp. is on stream with its field-processing plant at Glendive, Mont. The plant is processing around 6,000,000 cu. ft. of natural gas daily from Pine and Cabin Creek fields in Wibaux and Fallon counties in Montana. Residue is being sold to Montana-Dakota Utilities Co. Initial capacity for natural-gas liquids is 50,000 gal. daily. Texas Natural has eight other plants, all in Texas.

Ethyl Corp. has followed Du Pont in raising the price of tetraethyl lead antiknock compounds. Effective April 3, Ethyl's price will go up 2½ per cent. Motor will be 61.68 cents per pound of TEL content, and motor plus will be 62.68 cents and aviation 67.58 cents. This corresponds to 37.92 cents for motor, 37.48 cents for motor plus and 41.50 cents for aviation per pound of fluid.

Du Pont Co. has introduced a new motor-oil additive to combat sludging under severe stop-and-go driving conditions. Called No. 7 M.O.A., the new detergent works in the presence of water.

Sinclair Oil & Gas Co. is expanding capacity at its Gas Products Plant 27 near Sweetwater, Tex., to 9,000,000 cu. ft. with the installation of a 500-hp. compressor. The unit, the fourth at the plant, will have a capacity of 1,800,000 cu. ft.

The company is also adding a third compressor at its Wimberly booster station to hike handling capacity by 2,100,000 cu. ft. daily. The station gathers gas from Sweetwater Canyon field of Nolan and Fisher counties for processing at the Sweetwater plant.

Continental Oil Co. has shut down its Farmington refinery and will dismantle it. The 32-year-old plant, with a crude capacity of only 800 bbl. per day, was forced out of business by the octane race.

Continental Oil Co. and Santa Fe Corp. owned the plant for years after its construction in 1925. Conoco became sole owner in 1952.

United Farmers of Alberta Co-operative, Ltd., has bought out the company for which it formerly was a distributor. United paid a reported $1 million for Maple Leaf Petroleum, Ltd., acquiring 125 gasoline outlets in the deal.

Underground storage space for more than 25,000,000 bbl. of product was available as of last July and the capacity is continuing to expand, the National Petroleum Council has reported to the Government.

Contracts for a vinyl chloride mon-omer plant at Houston have been let by Diamond Alkali Co. of Cleveland, Ohio. The plant, to provide 50 million pounds a year, will be located at Diamond's Deer Park plant. Scientific Design Co., Inc., New York, has the design and engineering contract. Brown & Root, Inc., of Houston, will build the plant. It is scheduled for completion early next year.

The D-X Sunray Oil Co. refinery at Allen, Okla., will be dismantled by Heat & Power Co., Inc. The 11,000-bbl. plant, which has been shut down about 2 years, will be sold in units or individual pieces. The dismantling work will be handled by Kenneth A. Kallmeyer, Tulsa, vice president of Heat & Power.

Also for Refiners . . .

El Paso Natural Gas has taken another step to become a bigger refiner. The company, through its subsidiary, El Paso Natural Gas Products Co., will build a brand new 6,500-bbl. plant at Odessa (P. 100) . . . Importing companies have received a request from ODM Director Flemming to report by March 22 scheduled imports for the first 6 months following opening of the Suez (P. 101) . . . Murphy Corp. has moved into the marketing field through the purchase of River States Oil Co. A company official says Murphy may eventually get into refining (P. 108) . . . Ethyl's February survey shows national weighted averages dropped 0.1 for both regular and premium (P. 109) . . . LaGloria Oil & Gas plans to buy McMurrey Refining's custom blending plant at Tyler (P. 110) . . . Atlantic Refining is sticking to two grades (P. 112) . . . Stanvac plans to expand its South African refinery (P. 116).

PLUS THESE TECHNICAL FEATURES: Clean your cat reformer with acid—it takes off iron-sulfide scale (P. 183) . . . Cost-imating (P. 193) . . . and Equipment design and operation (P. 189).

Line Repair Approved

Syria, prompted by Israeli troop withdrawals, gives I.P.C. permission to begin putting crude lines back in operation

PRODUCTION workers at Iraq's big Kirkuk field were all but reaching for flow line valves late last week.

The Syrian Government finally gave Iraq Petroleum Co. the go-ahead on plans to put the damaged pipeline system back in partial operation.

The move came quickly after Israel's David Ben-Gurion bowed to United Nations and American pressure to pull his troops back to Israel. Syria had refused to allow repairs on the pipeline as long as Israeli troops were on Egyptian soil.

Iraq's action came almost simultaneously with estimates from Europe that second quarter oil supplies will be 95 per cent of normal. Officals of the Organization for European Economic Cooperation said about 8 per cent of deliveries will have to be set aside to build up stocks.

With the I.P.C. pipeline back in partial operation, this supply can easily jump to 98 per cent and, at the same time, allow Europe to cut back on its dollar buys of Western Hemisphere oil. Gasoline stocks in Britain last week were getting so heavy extra storage was needed. In Paris, automobile traffic was breaking all previous records.

Flowing this week . . . I.P.C. can have 220,000 bbl. daily of Kirkuk crude moving to eastern Mediterranean seaports by the end of this week if there are no hitches. The company says it can do preliminary repairs on the system within 7 days after the work starts.

One of the biggest delays will probably come in moving personnel and supplies back into Syria to begin work on the damaged pump stations. Once those first repairs are made, the line will have to be filled and tested for leaks. Then the crude can flow again.

Syria finally allowed about 35 I.P.C. engineers to inspect the damaged pump stations shortly after the first of the year following talks between Salah Bitar, Syrian foreign minister, and Geoffrey Herridge, an I.P.C. director. The engineers found the pumping eqnipment at all three stations destroyed. The lines themselves sustained little damage.

By using one pump station in Iraq, the system can be operated at about one-thrid its normal capacity. It will be months before the expensive job of replacing the damaged pumping equipment can be done.

For Iraq and Western Europe, even partial use of the system will be welcome. When the pump stations were sabotaged November 2, Iraq's normal production of 760,000 bbl. daily dropped to only 186,000 bbl. daily.

All but about 35,000 bbl. daily of that came from Iraq's southern fields which do not feed the pipeline system. With the drop in production, Iraq's oil revenues slowed to a trickle.

Suez Canal . . . In Egypt, the other major bottleneck to Europe's normal oil supply was still closed last week. Failure of the Egyptians to allow U.N. salvage crews to finish the job of clearing the Suez Canal was the hitch.

Officials say this job can be completed within 10 days. Egypt was accused last week by Secretary of State John Foster Dulles of "a tendency to drag its feet" on the clearance job.

Now that Syria has moved, Egypt probably will allow the canal job to be completed. It is doubtful that Syria would have changed its attitude without the approval of Egypt's strongman, Abdul Gamal Nasser.

Shallow Rig Explores Greek Isle

A CANADIAN drilling superintendent and an Israeli drilling crew landed last week on the Greek island of Zante (also known as Zakynthos) with a truck-mounted Mayhew rotary rig.

The shallow rig (see photo) is only rated to about 2,000 ft. and can easily go another 500, but that may be deep enough to give Greece an oil field. That's what three companies involved in the operation are counting on.

By this time, the light rig is punching its first hole on a 120,000-acre concession. It shouldn't take more than a couple of weeks to tell whether there's production below the heavy asphaltic crude that has been produced in small quantities on the island in years past.

The Zante operation got its start more than a year ago when a youthful St. Louis man, Martin Lerman, 26, formed himself an oil company. Lerman didn't know the oil business, but he got a concession for the island from the Greek Government and a quartet of private landowners. Since that time, Lerman has been trying to get his exploratory effort started *(The Oil and Gas Journal, October 24, 1955, page 77)*.

Last month Lerman's American-

Grecian Oil Co. made the deal that started things moving. The Greek Government gave its blessing to an agreement under which Israel Mediterranean Petroleum, Inc., and Pan-Israel Oil Co. took over an exploratory program as operator. The two sister Panamanian companies will spend $150,000 and drill 15,000 ft. of hole in the next 3 years for one-half interest. When those conditions have been met, American-Grecian will share the expenses

Greek history . . . Benjamin Heath, president of Israel Mediterranean, is about as optimistic about the whole operation as an oil operator can be without seeing some oil. The entire history of Zante contributes to this.

Oil seeps at Keri on the southern tip of Zante are believed to have furnished the ancient Greeks with caulking material for ships. This same asphalt gave the Greeks their secret weapon, the famed Greek Fire which was catapulted against foes in the ancient wars.

In later years, the Greeks found shallow production on the island, but never made a commercial enterprise out of it. During World War II, the Germans produced oil on Zante from shallow sands, but destroyed their installations ahead of the advancing Allies.

Heath said last week this German production came from 300 to 500 ft. His company plans to drill every test to the limits of its truck-mounted rig.

Drilling superintendent for the operation is James B Ogilvie, Calgary, who has been looking for oil in Israel. Ogilvie's rig and crew were shipped from Israel where both Pan Israel and Israel Mediterranean are active.

New Jamaica Test Planned

Jamaican Stanolind Oil Co. is preparing to spud a new wildcat in Jamaica after abandoning its first test in that country as a dry hole. Jamaican Stanolind is a subsidiary of Pan American Petroleum Corp.

Crews pulled out of 1 Santa Cruz after drilling to 8,732 ft. The well was located 5 miles south of Malvern in St. Elizabeth Parish. It was spudded last June.

The rig, capable of drilling to 14,000 ft., will be moved about 40 miles to the north in Trelawny Parish. The new location, now being cleared, is about 16 miles south of the town of Falmouth on the north coast of Jamaica. The test will be 1 Cockpit. No depth has been projected.

Jamaican Stanolind is scheduled to spend $2,000,000 by June 1958. This was part of the deal when the company took over the concession from Base Metals Corp.

It's a run for the money as . . .

Venezuela Grants Concessions

IT was a tossup whether there was more excitement in the last few pre-Lenten carnival days in Caracas or in New York banking circles.

The Venezuelan capital was in the midst of its revelry. Oil companies were scrambling for financing to back up bids they made February 11 on new oil concessions. There were some new faces in the crowd.

The Venezuelan Government very quietly notified interested companies back in January that it was ready to hear a second round of offers for new concessions. It gave the companies until February 11 to submit bids on tracts in five areas.

This time the government took steps to avoid the problem of flush bidders without any chips. In its first new offering of Lake Maracaibo tracts, several successful bids were finally cancelled because the companies didn't raise the money to back up the offer.

This time the ministry specified that successful bidders must put up the money within 8 days after being verbally notified that bids were successful.

Late in February the ministry began quietly calling in the successful bidders and notifying them which tracts they would receive. This started a run on New York banks for letters of credit to be filed with the ministry within the alloted 8 days.

Late last week, at least a dozen companies—several of them new to Venezuela—had filed those letters of credit in Caracas.

At stake were six more big Lake Maracaibo blocks and a total of 83 separate blocks in Barinas, Monagas, and the Gulf of Paria. Absolute minimum bids for the entire offering would cost the industry between $380 million and $400 million in bonuses alone.

Israel Pushing Oil Program

ISRAEL, surrounded on three sides by hostile Arab neighbors, is straining every muscle to get enough oil to satisfy the country's internal needs.

Last week it had settled down to an intensive three-pronged effort. Here's what is happening:

. . . Heletz field development is so intensive that it has all but halted other drilling programs in other parts of the country.

. . . Pipeline surveys are being made to extend the 8-in. line already under construction from Elath on the Port of Aqaba to Beersheba.

. . . Tankers have been chartered to feed crude to the pipeline. The Israelis aren't commenting at all on where these tankers will lift the crude, but government officials admitted last week that charters are being made. This would certainly indicate that Israel has contracted for a crude supply.

The Heletz development . . . The two companies which discovered Israel's first and only oil field have nearly dried up the rig market in Israel. There are now eight rigs at work in the field, all drilling development wells. A ninth rig is being used for workover operations.

The field, now producing about 1,000 bbl. daily, has nine producing wells. Another seven have been drilled to total depth, but are awaiting casing. Six more are drilling.

Only three deep rigs are drilling in Israel outside the Heletz field. In the southwest corner of the Beit Guvrin license, east of Heletz, Naphtha Israel Petroleum Co. is drilling below 5,400 ft. in Cretaceous limestone at Revaha 1. The well is being drilled on a farmout agreement with Pan Israel Oil Co., Inc., and Israel Mediterranean Petroleum, Inc., holders of the license.

Naphtha and Israel American Oil Corp. are drilling a deep test at Ein Gedi, near the Dead Sea.

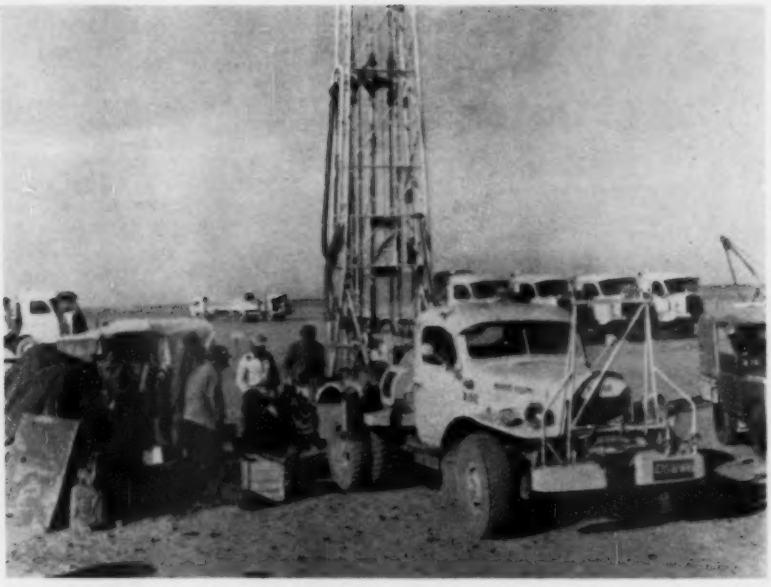
Lapidoth Israel Petroleum Co., Ltd., and Israel Oil Prospectors, the discoverers of Heletz, have set 7-in. casing to 6,300 ft. in a test near Sodom on the southwest shore of the Dead Sea.

The pipeline . . . Surveys have already been started on an extension of the Elath-Beersheba pipeline, which is not yet finished.

A Ministry of Development spokesman said last week that actual pipe laying is not likely to start before next month on the second leg of the line. Plans call for larger pipe than the 8-in. being laid to Beersheba.

The second portion of the line will connect Beersheba with an outlet on the Mediterranean at Wadi Shukreir near Ashkelon. The terminus will be about 30 miles south of Tel Aviv and 35 miles northwest of Beersheba.

A special government company is being organized to operate the pipeline.



DESERT SEISMIC PARTY breaks camp to continue its search for oil.

Algeria Perks Up

New deep discovery gives a big boost to French hopes for important new oil in the Sahara Desert area of Algeria

FRENCH optimism over Algeria's Sahara Desert as a major oil source got a new shot in the arm last week.

A new deep productive horizon at Edjele field deep in the southeast Sahara gave a further boost to talk of pipelines to get Sahara oil to the Mediterranean.

The ten wells drilled at Edjele since the discovery were completed at 1,000 to 1,500 ft. The new well is outside what has been considered the northern perimeter of the shallow zone.

The shallow Edjele wells produce from 20 to 50 bbl. an hour. One is on production. The crude is 35°-gravity and sweet. Output from the producer is being used as diesel fuel to run the rigs at the drill sites.

Five more wells have been completed in this shallow zone, but are shut in for lack of an outlet. Another is now being tested. Two of the tests drilled over a wide area were dry.

At Tiguentourine, 43 miles west of Edjele, an initial test yielded about 30 bbl. an hour of what the French described as high quality, sulfur-free crude from a zone between 1,500 and 2,000 ft. A second well is now drilling.

The Edjele and Tiguentourine discoveries were made by Cie. de Recherches et d'Exploitation de Petrole du Sahara (C.R.E.P.S.), in which the Royal Dutch-Shell Group has a 35 per cent interest. The remainder is owned by the French Government.

Pipeline pushed . . . C.R.E.P.S. officials said a short time before the new deep discovery was made that they were making "preliminary studies" of a pipeline. Since then, reports from Paris indicate these plans are being pushed further.

The most direct route to the Mediterranean from Edjele would be through Tunisia to a point near the Tunisian-Libyan border on the sea. It would be about 500 miles.

It has already been estimated that a similar line from the Hassi Messaoud discovery north to the Algerian coast would cost about $100 million.

The Hassi Messaoud discovery late last year has a pay zone estimated to be from 450 to 520 ft. thick at about 11,500 ft. Initial tests produced 950 bbl. daily and engineers say this rate could be increased to 1,800 to 2,500 bbl. daily *(The Oil and Gas Journal, December 31, 1956, page 104).*

This deep pay, which the French say indicates a reserve of 7 billion barrels, only last month prompted serious studies of a pipeline from well to railheads to the north *(The Oil and Gas Journal, February 18, page 118).*

The Hassi Messaoud well was brought in by Societe Nationale de Recherches et d'Exploitation des Petroles en Algerie (SN Repal), jointly owned by the Algerian Government and the French Government.

Joint exploration . . . Since the discovery, SN Repal has combined its exploratory effort in Central Algeria with another French company, Cie. Francaise des Petroles (Algerie).

The programs will be carried out on a 51-49 per cent basis by the two firms, with the division depending on the title on concession acreage where the work is being done. Both companies have extensive holdings throughout Algeria.

The most encouraging find of C.F.P. (Algerie) to date was at Laghouat, one of the railhead terminals proposed for a Hassi Messaoud pipeline. The well, HR 1, tested three gas sands totalling 174 ft. between 6,993 and 7,301 ft.

The well had mechanical troubles in the hole and was shut down without further drilling. A second well was spudded last week 8 miles west of HR 1.

British Alkylate Expanded

Shell Chemical Co. has expanded petrochemical production at its Shell Haven, England, refinery with the addition of a $4,500,000 alkylate plant. The new unit will more than double the company's output, exempt the country from dependence on imports, and provide it with an exportable surplus.

Present production is slightly in excess of 200,000 bbl. per year, less than enough to meet United Kingdom demand for dodecyl benzine. Demand has risen sharply as a result of the popular acceptance for synthetic detergents. Present requirements have been supplied in part by Shell's refinery in Curacao.

All the raw material for this and other units in the Shell chemical plant are supplied by Shell sources. Shell acquired the plant, formerly Petrochemicals, in 1955. Other producers of alkylate in Great Britain are Monsanto and Grange Chemicals.

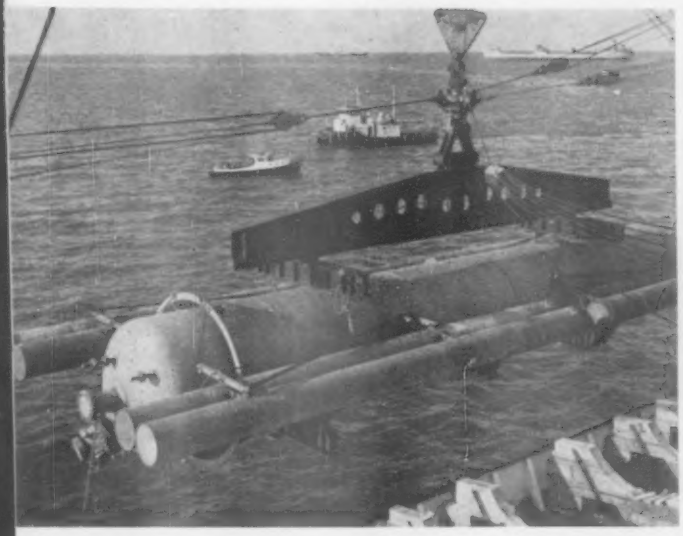
African Refinery Expanding

Standard - Vacuum Refining Co. of South Africa, Pty., Ltd., will expand its Durban refinery from 20,000 bbl. to 25,000 bbl. daily.

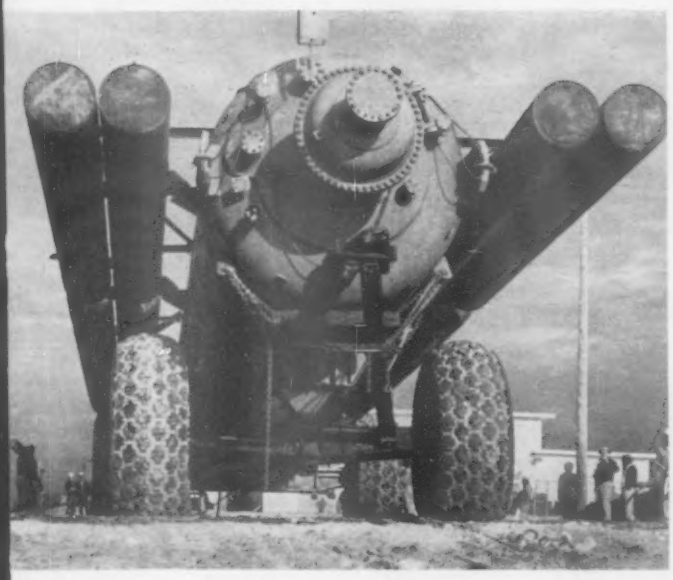
A Powerformer and Hydrofiner, along with minor additions to present equipment, will be built in 2 years. Foster Wheeler, primary contractor on the 3-year-old refinery, is general contractor for the expansion.

The plant is the only refinery in South Africa other than the Sasol coal-to-oil plant. It operates on Persian Gulf crude.

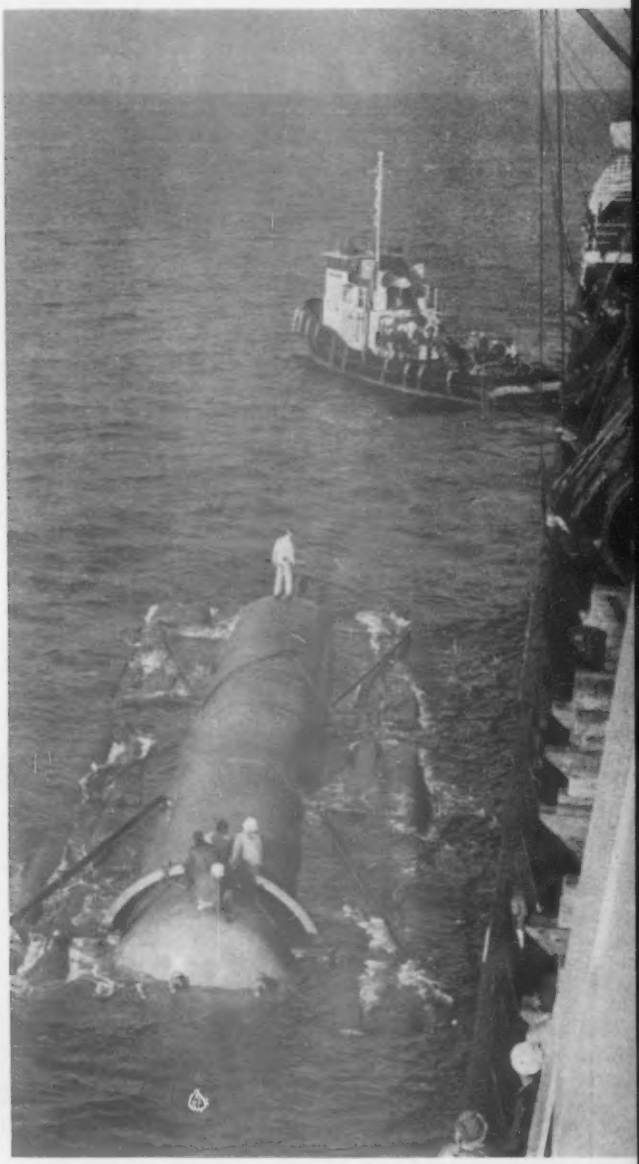
By Air . . .



And Land . . .



Sea . . .

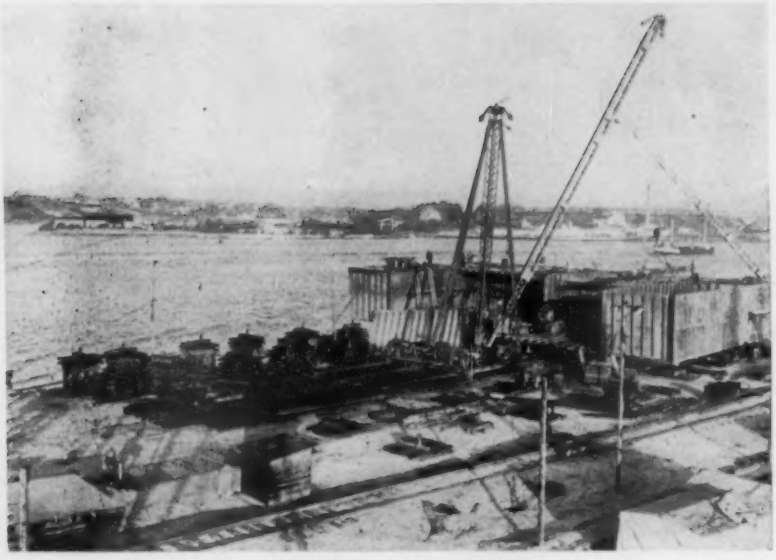


Reactor Column Moves to Ras Tanura

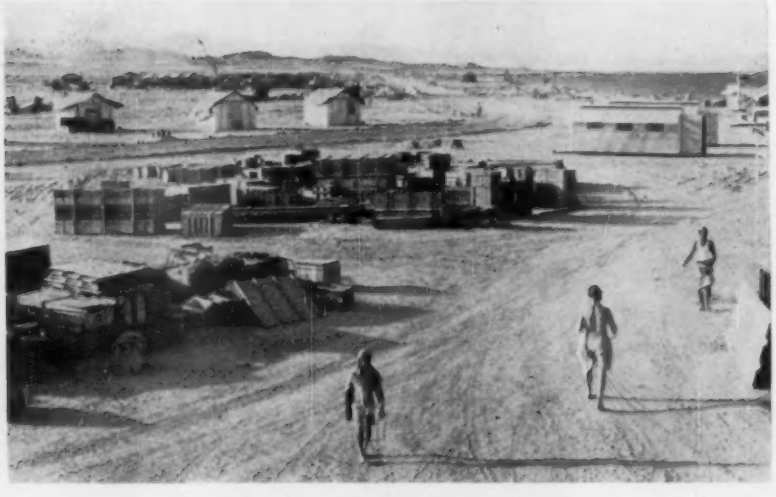
MOVING big refining columns is getting to be such a habit with Arabian American Oil Co. people that they hardly notice the big jobs anymore.

The latest was this 182-ton reactor column for a 15,000-bbl. daily Hydrofiner to desulfurize diesel fuel at Ras Tanura. Built in Berlin and shipped from Hamburg, the big reactor is probably the biggest vessel ever shipped complete with lining and all the internal piping and grids installed. On its arrival off Ras Tanura aboard the SS Braunfels, the big column was fitted with pontoons and swung over the side by crane and then floated ashore. Once ashore, the column was fitted with 10-ft. tires and trailer-like axles and rolled out of the shallow water to the construction site. The entire unit will be completed in July.

A reactor column for the Ras Tanura refinery's 14,000-bbl. daily fluid Hydroformer was transported and taken ashore on the Persian Gulf in the same way in 1955.



Barge being built in Germany and . . .



Camp going up on desert isle mean . . .

Persian Gulf Test Not Far Off

TWO beehives of activity a continent apart are setting the stage for an offshore test in the Persian Gulf.

Abu Dhabi Marine Areas, Ltd., will drill the well in 50 ft. of water. Location is 80 miles off the Trucial Coast and 20 miles from the island of Das.

A special camp (bottom photo) is being built on Das for the operation. It will include a storage area, air-conditioned sleeping quarters, and a dispensary. A breakwater and jetty are also planned.

The other center of activity is a shipyard at Audorf (top photo) on the Kiel Canal in West Germany, where a special DeLong barge is being built. The 4,000-ton unit will be towed to the Persian Gulf—and what a tow it will be.

Around the tip of Africa, the distance is between 12,000 and 13,000 miles. Through the Suez Canal, this would be cut to a mere 7,000 to 8,000 miles.

The barge will be capable of drilling to 15,000 ft. It will accommodate 50 men and have a helicopter platform. Hydraulic jacks will sink the four caisson legs to the seabed, then lift the barge floor 40 ft. above the water.

British Petroleum Co., Ltd., holds two-thirds interest in Abu Dhabi. Cie. Franciase des Petroles holds the remaning third. The companies spent several years in geophysical and geological work in the area before staking the well.

The test will be the third drilled in the southwestern part of the Persian Gulf. The other two were drilled by Shell Oil Qatar, Ltd., from the barge which was wrecked in December.

Fracture Pays Off

Offset will be completed if flow at 1 Catalina holds up

CUBAN AMERICAN OIL CO.'S 1 Catalina, the Cuban deep strike which had a brief flash of glory last summer and then fell off, has apparently responded to sand fracture. As a result, an offset probably will be completed.

On February 9, the first test after the fracture, the well flowed 127 bbl. of oil in 24 hours on ¼-in. choke. It has continued to flow since that date at rates varying from 40 to 80 bbl. daily, plus varying amounts of spent-acid water.

After flowing up to 1,000 bbl. of 35°-gravity oil daily on production tests last July, the well was completed for a disappointing 30 bbl. daily in limestone at 7,107-20 ft. *(The Oil and Gas Journal, August 20, 1956, page 116).* The well is located about 4½ miles southwest of Jatibonico field in Cuba's central basin.

Cuban American, which should be about through with clean-up work at the well, said it is waiting for final results of the sand-fracturing job before completing 2 Catalina in the same formation encountered at 6,892-24 ft. The offset is 1,320 ft. southeast of 1 Catalina.

In a 1-hour drill-stem test of the zone, 2 Catalina recovered 558 ft. of pipeline oil. Several shows of oil and gas were encountered below the pay zone, but none appeared to be commercial.

Other drilling . . . Cuban American has released its last seismograph crew in Cuba, but the company is planning an active exploration program during the remainder of 1957.

The company plans to drill six slimhole tests on its concession held jointly with Trans-Cuba Oil Co. and Cuban Venezuelan Oil Voting Trust. Three of the tests would be located on the south side of the concession, two on the east, and one on the north.

What's ahead for NATURAL GAS?

● If the gas industry is to keep on growing it must first find out what it costs to develop new reserves. Replacement cost is the key to price regulation—and Congress isn't likely to change the law in this respect. An article by a Journal natural-gas specialist tells why—and a little bit of how—producers must start getting cost data.

p. 120

● Automation for natural-gas pipelines is moving ahead rapidly. A big, bold step into the future is being taken. And Gulf Interstate is leading the way. It's developing engine-driven centrifugal compressor stations specially designed for remote control. This pioneering effort—and what it will lead to—are discussed in this special section.

p. 126

Technical articles in this issue bring you up to date on

› Compressor-foundation design—where improvement needs to be made.

p. 129

› The A, B, C's of why and how pipe corrodes, and how corrosion is controlled.

p. 133

› Solving a sour-wet-gas problem in a hurry.

p. 143

› What's good and bad about centrifugal compressors.

p. 148

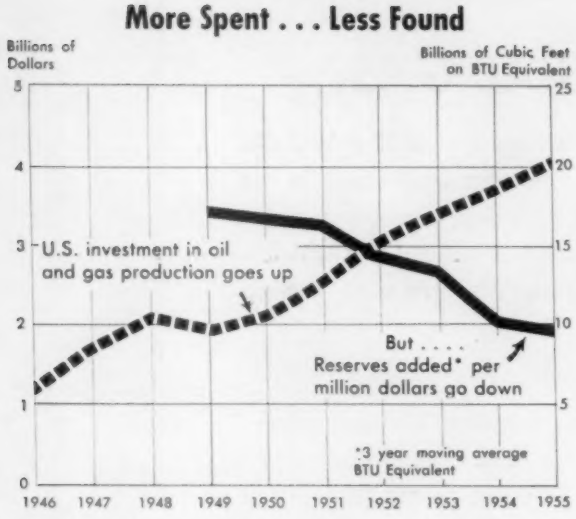
› One of the most efficient two-cycle turbocharging systems known.

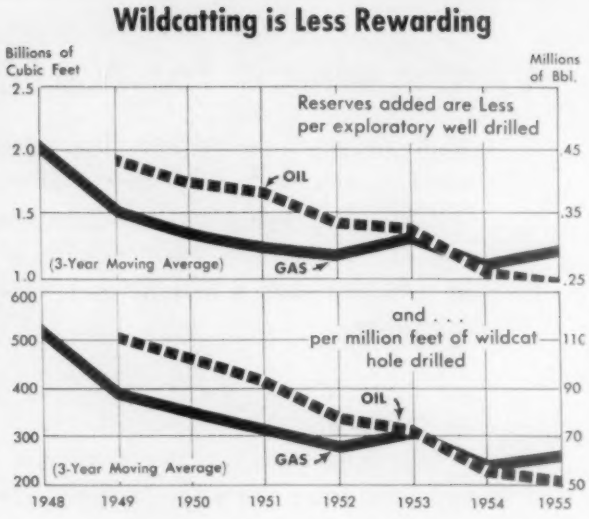
p. 164

› Figuring out how long your gas reserves will last.

p. 173

This issue contains a wall map of crude, products, and natural-gas pipelines


More Spent . . . Less Found
Billions of Dollars
Billions of Cubic Feet on BTU Equivalent
U.S. investment in oil and gas production goes up
But . . . . Reserves added* per million dollars go down
*3 year moving average BTU Equivalent
1946 1947 1948 1949 1950 1951 1952 1953 1954 1955


Wildcatting is Less Rewarding
Billions of Cubic Feet
Millions of Bbl.
Reserves added are Less per exploratory well drilled
OIL
GAS
(3-Year Moving Average)
and . . . per million feet of wildcat hole drilled
1948 1949 1950 1951 1952 1953 1954 1955

Today's jackpot question . . .

What Does It Cost to Find Gas?

● Nobody knows. But the growth of the natural-gas industry depends on the answer. And the industry must find the answer if it is ever to get field prices increased.

● Neither Congress nor the Federal Power Commission will accept general statements that higher prices will bring increased gas reserves. They insist on specific figures.

● This article tells why . . . and suggests a few elements that might go into an industry-wide figure on how much it costs to explore for and develop natural-gas reserves.

by Henry D. Ralph

THE key to the growth of the natural-gas industry is the cost of developing future reserves.

This is not an academic problem. The Federal Power Commission is wrestling with it now. Congress will be debating it in the near future. Producing companies, gas pipelines, petrochemical plants, and utilities are vitally concerned.

Demand for gas is growing faster than new discoveries. New discoveries cost much more than they used to. The present trend indicates that gas supplies brought on to the market in the future will cost considerably more than the prices now being paid for gas obtained from older fields.

Will this mean that the price of gas will be too low to warrant the search for new reserves?

Will new supplies be too uncertain to warrant investment in new pipelines, petrochemical plants, or other projects which need to be assured of supplies for 20 years or more?

Two things are certain:

. . . **1. Tremendous pressures** will operate to increase the price of gas up to—at least—the intrinsic value of its heat content compared with other fuels. This despite a number of retarding factors, principally governmental efforts to hold prices down.

. . . **2. Producers will not long spend** the huge sums necessary to explore for additional gas unless they can foresee the probability of prices permitting them to recover their costs.

Deceptive reserves . . . Right now it may look as though there is plenty of gas in sight for the future. Reserves have been climbing, and at present proved reserves are about 22 times annual consumption. This compares with crude reserves of only 12.5 times annual consumption.

But this is deceptive, for these reasons:

. . . **Gas consumption** has been going up faster than oil consumption.

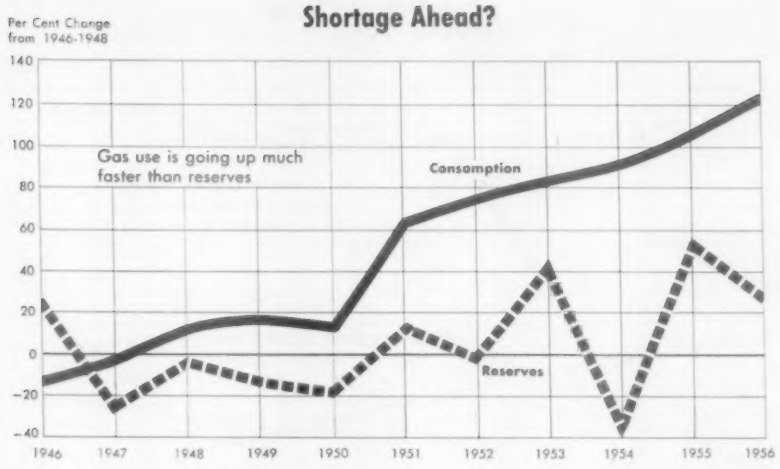
. . . **Gas supplies** can't be augmented by overseas imports.

. . . **Because gas fields,** by and large, are found at greater depths than oil fields, it takes more money per unit of energy obtained to discover gas.

Decline in deliverability, as field pressures fall off, makes it necessary to keep adding new reserves to existing pipelines in order to keep present customer commitments satisfied.

In fact, some experts estimate that if we don't discover new gas reserves

Natural Gas--Gas Pipelines



"It would be a tragedy for the United States to run out of natural gas. But it would be a double tragedy if this were caused—or hastened—by unwise government policies. This could happen. A low price of gas today could mean a scarce supply in a few years . . . whereas a high price today could assure abundance far into the future."

at 1½ times the annual rate of consumption, some existing pipelines will be operating at less than capacity within about 10 years.

Replacement is the key . . . The price of natural gas has been a political football for several years. But only now is it becoming clear that the heart of the issue is the cost of finding new reserves.

This figure—replacement cost—is the key to what the price of gas ought to be today as well as the key to the volume of supplies this country will have in the future.

If it were not for the political angle, this problem might more or less take care of itself. In any industry, individual producers worry about their replacement costs. If a merchant can't make enough on current sales to restock his inventory, if a producer sees that he can't raise prices enough to cover his increased costs, he quits and goes into some other line of activity. This process can eliminate an entire industry if its customers—for any reason at all—don't pay enough into it to keep it going.

The natural-gas industry could disappear this way over a period of years. One by one producers would go bankrupt or conclude that the game isn't worth the candle. It's conceivable that some time in the future this could happen anyway, regardless of costs and prices, by physical exhaustion of all the natural gas actually on this continent. That's what happened to the buffalo-robe industry. But the gas industry is confident that it can put off this evil day for several generations—that there is plenty of gas to be found if the customers will pay the cost.

It would be a tragedy for the United States to run out of natural gas. But it would be a double tragedy if this were caused—or hastened—by unwise government policies. This could happen. A low price of gas today could mean a scarce supply in a few years, whereas a high price today could assure abundance far into the future.

Soaking in . . . The truth of this is just beginning to soak in on regulators and customers alike.

At the moment it's a burning issue before the Federal Power Commission. In its attempt to regulate producers' prices as directed by the Supreme Court in the Phillips decision of 1954, FPC is deep in the heart of the problem of determining what price for gas today will maintain supplies for tomorrow.

Of course all producers hope that Congress will amend the law, and soon. But there's hardly a chance that Congress will get away from this problem of determining replacement costs. The only way to do that would be to remove every shred of a check on the prices that interstate pipelines pay for gas—and nobody expects that.

Here's why the problem will remain:

Last year the Harris-Fulbright bill passed both House and Senate, only to be vetoed. It presumed to free producers' prices from FPC regulation. But it did require FPC to make sure that gas prices to interstate pipelines do not exceed the "reasonable market price." And one of the elements listed for determining this was "the effect of the contract upon the assurance of supply." That language, in the final analysis, is just another way of saying that FPC must determine replacement costs.

Now a new bill is being prepared for submittal to Congress. Drafts have been worked over by committees of producers, pipeliners, and distribution companies. The object is to eliminate most of FPC'c present control over producer prices.

But, in certain key contracts—in a relatively few but highly important sales which would have a strong influ-

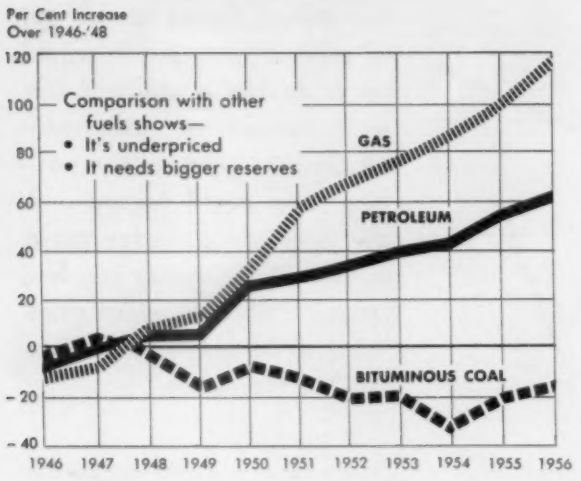
Deep Gas Isn't Paying Its Way

Depth, ft.—	Initial gas-liquid ratio cu. ft./bbl.	Producers' revenue* Liquid	Gas	Total	Revenue from gas, per cent of total
Oil reservoirs:					
2,000	300	$705	$ 33	$738	4.5
5,000	500	531	49	580	8.4
10,000	1,000	345	79	424	18.6
15,000	2,000	240	117	357	32.8
Gas-condensate reservoirs:					
5,500	98,000	$ 23	$109	$132	82.6
10,200	25,000	102	163	265	61.5
12,400	48,000	83	197	280	70.4

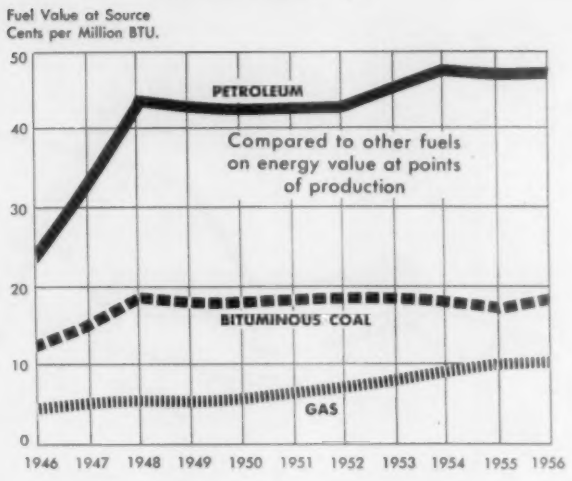
*Based on: Oil at $3.00/bbl.; condensate at $3.30/bbl.; gas at 15 cents/bbl.; 1 acre-ft. of formation.

FUNDS FOR DRILLING. When the industry was selling mostly shallow gas it could afford to finance exploration out of oil revenues. But the deeper the drilling, the higher the percentage of total finding costs must be borne by gas sales.

Gas Consumption



Gas is Cheap . . .



ence on all gas prices—FPC would have to determine the "reasonable market price." And the latest draft of the proposed new bill gives as the first element of this "whether the price as determined by it will assure to consumers a continuing adequate supply thereof."

Now FPC itself, in its recent annual report, recommends that producers be freed from most utility-type regulation but that FPC should "weigh the interests of the consumer in low prices with the necessity of providing assurance of future gas supplies." That's just another way of saying that replacement costs will remain the basis of price control.

The new legislation would, of course, greatly simplify FPC's work, free most producers from direct regulation, and bring new flexibility into gas prices. But it won't completely eliminate governmental interference in arriving at gas prices sufficient to insure development of new reserves.

Connole's views . . . In a footnote to the FPC annual report, Commissioner William R. Connole concurred generally but stated that any legislation must permit the commission to consider costs and revenue requirements where necessary and useful, for to do otherwise would risk the prohibition of their consideration. He stated that if costs could not be used, it would restrict consideration to the demand for, and eliminate consideration of the cost of, natural gas—thus ignoring an essential element of reasonable value. Moreover, he said if the commission were not permitted to consider cost, the producing industry would be deprived of a constitutional protection against confiscation which all other natural-gas companies enjoy.

Shortly before the annual report was issued, Commissioner Connole expanded his views on this subject in a public speech, which contained these significant quotes:

"The idea seems to be gaining general recognition that revenue requirements, however measured, must form the fundamental basis on which any objective standard of justness and reasonableness would be measured.

"Revenue requirement need not, in my judgment, be determined for each individual sale from each individual wellhead, field gathering point, gasoline plant, tail gate, or other point of sale. But revenue requirements should be used when setting out touchstones against which to determine the principles to measure the reasonableness of those particular sales.

"In other words, the starting point ought not to be how much can the gas bring. Rather it should be, how much does the industry need to compensate it adequately and to insure the continuation of exploration and development.

"One of the biggest regulatory problems is how to measure and adequately compensate for the risks involved in exploration and finding and bringing natural gas to market. Here is an area in which the services of those dealing with opportunities for alternative investment can make a real contribution, for certainly the risk element in a gas-producing enterprise must be subject to measurement.

"My point is not to ask for a formula or even to suggest that one is to be found with sufficient searching. Rather, I urge that study be given to evaluate the quantity of risk inherent in any business enterprise. Then, and only then, can the regulatory body address itself to the problem of individual sales."

Commissioner Connole then drew a parallel with the job of the Interstate Commerce Commission in passing on the reasonableness of thousands of individual freight rates every year. He said that no individual rate is measured by the amount of return on investment it will yield, but that the whole body of rates is maintained at a level that will keep sufficient capital flowing into the railroad business. He continued:

"I suggest only this much: That any study of the subject must begin with a knowledge of how much money is required for actual operation.

"Whether risk in this industry is best measured by the amount of capital devoted to it, by the relationship between operating expenses and operating revenues, or whether some other means not yet used by regulatory authorities shall govern has not been adequately urged by any group.

"Certainly, however, the answer is not beyond reach. Experts have advised institutional investors and others of the wisdom and propriety of making an oil loan or otherwise assisting in the financing of producing properties.

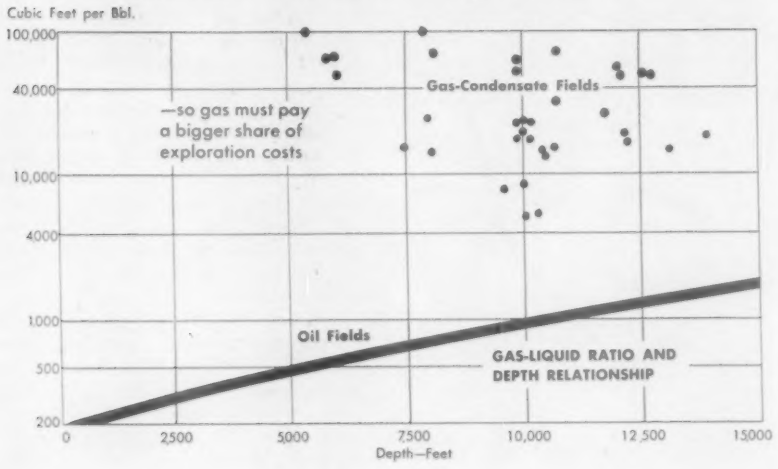
"Moreover, every producer—be he the legendary hat-band-filing-system type or a giant integrated major company—whenever he decides to go ahead and contract for a drilling rig to spud in on a particular piece of the earth's surface, he forms a judgment—or several judgments, in fact.

"When these several factors for judgment are analyzed in their manifold detail they will yield meaningful conclusions that will set us well along toward establishing the standard we seek.

"Applied common sense, business

Natural Gas—Gas Pipelines

More Gas . . . Less Oil in Deeper Fields . . .



know-how, and regulatory expert opinion will then solve technical questions of cost allocation as they have done in the many fields to which regulatory processes have already been applied."

Nub of the problem . . . Until we have a new law, FPC must try to fix producers' prices on the basis of the classic cost-base formula for public utilities.

This formula has a number of elements (all controversial as applied to gas production). But the most important one of all is a rate of return on investment which will attract sufficient capital to assure adequate service.

That's the nub—the essence—of public-utility regulation. Most of the argument in a typical rate case concerns accounting procedures and details of cost of prior investment and cost of current operations. But when that is all over, the duty of a regulatory commission—and the area in which it must exercise the most discretion— is to determine a rate of return on investment (above operating costs) that will keep investors putting money into that business in just enough volume to keep the business expanding in line with anticipated demands.

In the gas business, that means wellhead prices that will encourage wildcatters to take the risks of exploring for new reserves.

In the utility business it isn't difficult to fix a tolerably accurate rate of return. Experience has shown that something in the vicinity of 6 per cent will usually do the trick. The proper rate obviously must be related to the amount of risk involved compared to the yields on less-risky and on more-risky investments.

Everyone admits that wildcatting for gas is more risky than buying utility bonds, so gas producers should get a higher return than 6 per cent. The question is how much more.

Here's one way of looking at it: If the wildcat success ratio is one good well out of nine dry holes, the rate of return should be nine times that on the safest possible investment. So take the 3 per cent paid by savings banks and multiply it by nine. This would entitle a gas producer to a yield of 27 per cent on his investment in properties that succeed in producing gas—after deducting current operating costs.

That may be an oversimplification,

Dry-Gas Fields Are Losing Importance

Source of marketed gas—	U. S. annual volume, M.M.c.f.			Per cent of total gas		
	1945	1954	1955	1945	1954	1955
Dry gas wells	2,594,747	3,918,237	4,038,622	66.2	44.8	42.9
Oil and casing-head gas wells	687,535	2,140,873	2,405,108	17.6	24.5	25.6
Gas-condensate wells	636,324	2,683,200	2,961,234	16.2	30.7	31.5
Total gas	3,918,606	8,742,310	9,404,964	100.0	100.0	100.0

DEEP GAS. If you expect to find big gas sources you have to drill deep. What this will cost is now the big issue in gas prices.

"Everyone admits that wildcatting for gas is more risky than buying utility bonds, so gas producers should get a higher return than 6 per cent. The question is how much more."

but it illustrates the nature of the problem.

To the man on the street—and to the FPC and state utility commissions —anything approaching 27 per cent return may seem unconscionably high. But who knows what is the proper rate? Who can tell how much profit an oil and gas producer needs on his sales to cover his losses in unsuccessful exploration, how much to keep him interested in hunting new reserves rather than putting his money in some less-risky enterprise?

No answer . . . The industry can't answer that question. At least it has failed to answer it in every case but one in which FPC has asked it. That exception is Phillips Petroleum Co.

In every other case (except three insignificant ones that didn't set real precedents) which has been decided by FPC, producers have been denied an increase in prices because they were unwilling (more likely unable) to tell their cost of staying in business. In most cases they didn't even try to ascertain the cost of acquiring and developing the reserves they are now selling at known prices nor their annual out-of-pocket operating costs, let alone how much money they would have to plow back into the business to find new gas reserves to replace those now being depleted.

But FPC insists on knowing, and here's why:

In the Panhandle rate case (City of Detroit vs. FPC) the commission attempted to use the average field price as the proper basis for evaluating the worth of gas produced by a pipeline itself. It said that the increased revenue thus accruing to the pipeline would encourage it to explore for more gas, and this was in the public interest.

But the federal Court of Appeals (sustained by the Supreme Court) had other things to say. It did not deny that it is in the public interest to encourage development of new supplies, and it approved a regulatory approach to this end. But it added:

"If the commission contemplates increasing rates for the purpose of encouraging exploration and development . . . it must see to it that the increase

is in fact needed, and is no more than is needed, for the purpose."

Thus FPC has a specific court mandate, as well as its general responsibility as a rate-regulating body, to determine how high the price of gas should be to encourage exploration.

A dozen or more big gas producers have failed to get their prices increased on this account. They have argued that the utility method is improper as applied to gas production. They have contended that it is futile to try to ascertain costs of production and particularly costs of finding gas. They have put into the record some generalized observations about the necessity for a price high enough to maintain supplies.

Why Union failed . . . A typical example is the case of Union Oil Co. of California, et al., which was pending before FPC for 2 years and was finally dismissed last December. It follows the pattern of most producer rate cases to date.

Union and the others had a temporary contract to sell gas to Transcontinental Gas Pipe Line Co. from a new field in Louisiana for 9.797 cents per M.c.f. After the field was partially developed and it was possible to make an estimate of its reserves and production costs, a long-term contract was signed. The price was increased to 17 cents, but Transcontinental was assured of a much larger and longer-lasting supply.

FPC suspended the increase and demanded that the producers prove that it was "just and reasonable." Union and the others showed these things:

. . . The price was the result of arm's-length bargaining between parties with no affiliation with each other. Neither party was under any special compulsion to make a deal.

. . . The price of 17 cents was not above the prevailing rate for similar contracts in the same producing area.

. . . Transcontinental got *quid pro quo* —valuable consideration in return for the higher price. The pipeline was entirely satisfied with its bargain and asked FPC to approve the rate.

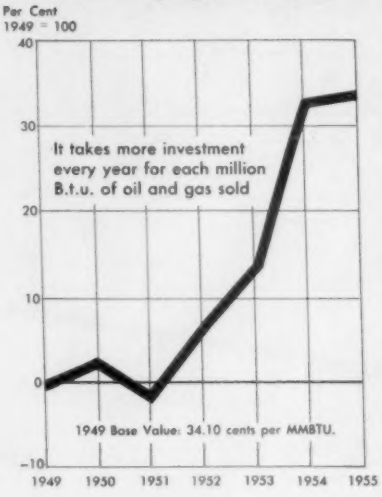
. . . The producers turned down offers from other pipelines for the same or slightly higher prices at the wellhead.

. . . Transcontinental could sell the gas in the New York-New Jersey area at prices competing favorably with the prices of coal and fuel oil for space-heating and boiler-fuel uses.

. . . Higher field prices are necessary as an incentive to continued exploration and development of new gas supplies. But they didn't say what price figure is needed to develop a given volume of new reserves.

So FPC rejected the price increase.

Cost of Staying in Business



It found no fault with any of the producers' evidence so far as it went. But it said general statements about higher prices encouraging exploration are not enough. It demanded specific figures related to the price at issue.

"On this record," said the majority of FPC, "it is not possible to strike a balance between investor and consumer interests. We cannot be sure that the rates are sufficient to promote exploration for and development of gas supplies and, at the same time, to provide the protection to the ultimate consumer contemplated by the Natural Gas Act. . . .

"It is impossible to meet the requirements of either the act or the constitution unless we can determine the revenue requirements of the industry we must regulate and the effect of the rate in question on its earning capacity."

Two commissioners (Stueck and Digby) dissented. They said the commission had a responsibility to the industry and to the public to take some positive steps to find the answer, that it should tell the applicants exactly what sort of figures the commission wants, and if they are unable to develop them the commission itself should try to get the figures elsewhere.

But note—and this is very important—the two minority commissioners did not disagree with the majority that FPC must have some statistical evidence by which it can judge whether or not a certain wellhead price is enough or too much to provide the financial incentive for continued exploration. For all the record shows, they said, the original 9.797 price might be too high for this purpose.

Answer must be found . . . So FPC is unanimous in demanding that wellhead prices be related to the producers' need for revenue for exploration and development of new supplies.

And it appears that no law which Congress is likely to pass will remove this requirement entirely. Both the Harris-Fulbright bill and the proposed new bill would free many field prices from any regulation whatever. They would remove the remainder from the detailed and inapplicable utility-rate-base requirements and stipulate that gas should be priced as a commodity rather than as a service.

But new legislation is almost certain to continue the requirement that wherever FPC has any say about a gas price it must consider the effect of the price on future supplies.

This makes it imperative that the producing industry get busy at developing some acceptable figures on what it costs to find gas.

Only one case before FPC gives promise of developing such figures. This is the case of Phillips Petroleum Co., currently in the middle of hearings. It is different from all the others. In the other cases, producers came before FPC with a request for approval of higher prices.

In the Phillips case, FPC ordered an investigation of its prices to interstate pipelines. This shifted the burden of proof—at least initially—to FPC itself. Its staff spent months going over Phillips' books. And because Phillips had been threatened for years with just such an investigation, its books presumably were in better shape for this purpose than the books of most other gas producers.

The FPC staff tried to get from Phillips' books the figures that would show these three principal things:

. . . 1. How much capital Phillips invested in finding and developing the gas reserves now being used to supply its interstate customers.

. . . 2. Phillips' annual out-of-pocket cost of operating these properties and supplying gas to interstate pipelines.

. . . 3. What rate of return on its investment (above operating costs) Phillips needs to keep it in the business of finding additional gas.

The first two points involve a wide array of factors and arguments. Phillips claims that the staff fell far short of the mark. It is now in the process of knocking down the staff's methods and trying to prove that its investments and its costs are very much higher than the staff figured. But both these first two points are possibly susceptible of being solved by applying accounting methods and interpretations to available figures.

The first approach . . . The big ques-

You Have to Go Deep to Get Big Gas

Depth, ft.—	Initial gas-liquid ratio, cu. ft./bbl.	Contents of 1 acre-ft. of reservoir rock: Stock-tank liquid, bbl.	Contents of 1 acre-ft. of reservoir rock: Gas, M.c.f.	Recovery from 1 acre-ft. of formation: Stock-tank liquid, bbl.		Recovery from 1 acre-ft. of formation: Gas* M.c.f.
Oil reservoirs:						
2,000	300	782	235	*235	†469	223
5,000	500	708	354	*177	†425	329
10,000	1,000	577	577	*115	†346	525
15,000	2,000	438	875	*80	†263	779
Gas-condensate reservoirs:						
5,500	98,000	8	810	*7	†5	729
10,200	25,000	48	1,210	*31	†30	1,089
12,400	48,000	31	1,462	*25	†19	1,316

*Solution-gas-drive recovery. †Water-drive recovery.

NO LONGER A BYPRODUCT. Increasing quantities of gas are coming from wells which also produce petroleum liquids. This means gas sales must bear their proportionate share of the cost of these wells.

tion is No. 3. The staff tentatively and timorously used the figure of 9 per cent return on investment "as a starting point." It wouldn't advance an opinion as to whether 9 per cent is even in the ball park. It left that to be decided by the commission itself after the hearings are concluded.

Phillips came back with the assertion that it needs at least 12 per cent return on its producing properties to offset its losses in unsuccessful exploration. (And this would be 12 per cent on a "rate base" much higher than the FPC staff figured it.)

The company's net return on investment (before provision for federal income taxes) has declined steadily from a high of 29.5 per cent in 1948 to 10.7 per cent in 1954, 11.9 per cent in 1955, and 8.3 per cent in 1956. Since 1946 its net investment per unit of production has increased by 123 per cent. This means that if it cost $75,000,000 to develop a field delivering 100,000,000 cu. ft. per day in 1946, it would cost $167,000,000 to develop a similar field today.

Deep gas . . . In addition to figures on its own operations, Phillips made some industry-wide studies of direct bearing on the big question before FPC.

Its most impressive argument is that gas has not carried its proportionate share of the total oil-and-gas exploration effort, but that it will have to carry the major part of this cost in the future.

It may have been true 20 years ago that gas "costs nothing" because it is a mere byproduct of the search for oil. But not today, because of two factors:

. . . The deeper the drilling, the higher the ratio of gas to crude oil in the average reservoir.

. . . Condensate fields, found at great depths, yield chiefly gas.

At 15,000 ft. an operator can expect to find one-third as much crude oil and three times as much gas as in a similar reservoir at 3,000 ft. And if he hits a condensate field he can expect 10 per cent as much oil and 300 times as much gas as in a 3,000-ft. oil field.

This has caused a "startling transition" in gas sources. In 1945, 66 per cent of all marketed gas came from dry-gas fields, 18 per cent from casing-head gas, and 16 per cent from condensate fields. Now the percentages are 43 for dry gas, 26 for casing-head, and 31 for condensate.

This shows the dependence of consumers on deep—and expensive—gas reserves.

It also shows how the producers' income must shift from chief dependence on oil sales to greater proportion from gas sales. For example, with gas selling at 15 cents per M.c.f., a gas-condensate well has to produce $15 worth of gas to produce 1 bbl. of oil worth about $3, or a total income of $18. The same total B.t.u.'s produced from a shallow well will bring the producer $50 worth of oil and only $1 worth of gas, or a total income of $51—almost three times as much income as from the deep well.

A way out? . . . Some of the tables and charts with this article are among the exhibits Phillips presented the FPC. (Others were prepared by The Oil and Gas Journal from reliable sources expressly for this article.)

These data represent some of the types of material which producers must supply FPC if they hope to get prices increased—data bearing on the actual cost of developing new gas reserves to replace those now being sold at low prices.

Phillips may or may not win its case and get higher prices. But in any event it will have given FPC some of the first specific evidence of the type FPC needs. If Phillips does win, the higher prices will, of course, apply only to its own sales.

But then other companies can follow a similar plan and submit their own cost figures plus any other industry-wide studies that may be available. Gradually a pattern may emerge—a body of evidence showing how much money must be spent in exploration to keep the gas industry growing.

Will every producer, large and small, have to go through this expensive procedure? Not necessarily.

For reasons that can only be guessed at, FPC recently published a study of direct sales by producers of natural gas to interstate pipelines. This shows that of nearly 5,000 independent producers, 9 of them (alone or as sales agent for a group) supplied more than one-third of the total, while 72 supplied 79 per cent.

So, conceivably, if FPC should get from the top dozen or two suppliers of interstate lines the figures on their own exploration costs and results, plus whatever industry-wide studies that might be supplied to it from any source, the commission might have the basis for arriving at figure for "rate of return" that would mean something. After that, individual smaller producers might be able to justify their price increases by relating them to the experience of these industry leaders.

It's a formidable job for even a big company like Phillips to demonstrate to a discriminating tribunal like FPC that gas supplies will run short in X number of years unless producers get Y cents per M.c.f. at the wellhead.

Maybe the job can never be done with mathematical exactness. But if producers ever expect to get higher gas prices—either from FPC or through action of Congress—they had better bend every effort toward putting together a body of statistics that will serve as prima facie evidence that prices within a certain range are demonstrably necessary to bring out the new reserves needed by this nation down the road.

The charts and tables accompanying this article give a few samplings of the sort of evidence that might contribute to this result. **End.**

Gulf Interstate wanted to know . . . and experimented to find out . . .

Is Automation Feasible for Gas Pipelines?

by Sy Orlofsky

AN example of what can be done, and what is being contemplated in automation in the gas industry is reflected in the work of Gulf Interstate Gas Co. This company since its inception has recognized the benefits to be derived from the automatic operation of main-line compressor stations. The company has approached the problem with caution by first constructing and operating semiautomatic plants before shifting to completely automatic installations.

To determine the feasibility and economics of automatic compressor stations, Gulf Interstate on an experimental basis constructed in 1955 the Stanton, Ky., compressor station. The Stanton plant was designed to be operated completely automatically, and to be controlled from a manned reciprocating station located 8 miles south of Stanton The station was completed and placed in operation on December 21, 1955.

Unattended operation was started on March 27, 1956. Since that time Stanton has run over 8,000 hours with a minimum of mechanical or control failures. Far fewer difficulties have been encountered at Stanton than at many Gulf Interstate's attended reciprocating plants. The Stanton station has proved that existing instrumentation and feed-back systems have come of age, and are now available where control of compressor stations from remote locations is fully possible.

The author is general superintendent, Gulf Interstate Gas Co., Houston.

Four more stations . . . Based on the results of the Stanton compressor station, Gulf Interstate has designed and is constructing four more single-engine automatic compressor stations, and is adding an engine at Stanton. This work will be finished and in operation this month. As soon as a certificate of public convenience and necessity is obtained from FPC the company will fully power these automatic stations.

A fully powered plant will consist of four 3,500 hp. turbocharged gas engines, driving a centrifugal compressor through a gear-speed increaser. The five automatic stations with four engines each should be in operation by the end of 1957. The operational control of the entire pipeline, including the automatic operation of the five centrifugal stations, and the automatic control of two transport measuring stations located at Means and Leach, Ky., will be realized from a central dispatching headquarters at Nashville, Tenn.

Dispatchers at Nashville will be able to completely control the operation of the five centrifugal plants and the two transport measuring stations. The basic information to run the system will be automatically logged at Nashville.

The automatic stations will have no operators in attendance. For these five locations the maintenance crew will consist of a station foreman, five repairmen, and three maintenance men. The automatic centrifugal stations are located at Stanton, Ky.; Hartsville, Tenn.; Corinth, Miss.; Inverness, Miss.; and Alexandria, La. The compressor stations spaced between the automatic plants are the initial five semiautomatic reciprocating stations placed in operation on November 1, 1954.

These five stations will be expanded from a present rating of 10,000 to 14,000 hp., during the same program of fully powering the automatic stations. The reciprocating stations have only one operator in attendance per shift. The operating and dispatching center at Nashville will have the ability to request automatically the running conditions of the reciprocating stations. However, the actual operation

"Automation can no longer be ignored"

MANY people of our industry are misled by the word "automation." They do not understand the full meaning of the word. Many support the theory that automation is no problem, or has no advantages, if only we can ignore it.

Automation can no longer be ignored. It is playing an increased part in the life of all industries and all civilized countries. Actually, the future economic lives of many industries are in jeopardy because of failure to investigate the full significance of automation.

Automation can be defined as the science of using devices and instruments to handle and control information for purposes of creating self-regulating systems. Actually, automation has been with us well over 200 years, since the dawn of the first industrial revolution.

Many believe that we are entering a second industrial revolution, with automation being the motivating force. Actually, this idea has been promoted by the speed which automation has developed since the end of World War II. The war effort contributed greatly to advancing the science of automatic machines and production methods because of the scarcity of skilled manpower.

Benefits . . . Automation opens for the gas industry unlimited possibilities for conditioning and transporting natural gas with greater safety, increased dependability, and lower transmission costs. Its gains are already evident in automatic dehydration, desulfurization, and stripping plants for gas conditioning.

Many automatic transport measuring stations and field booster compressor stations are presently in operation. The next major step is automatic main-line compressor stations, controlled from a central location. What are the benefits of automatic compressor stations? They are many:

1. The automatic handling of information at, and from, compressor stations increases the versatility of the pipeline whereby it can be kept at high performance levels.
2. The judgment of sensing instruments can be made infallible, while the human judgment it replaces is not infallible, resulting in stations that are safer.
3. The unit transportation cost of gas can be reduced.
4. Information required to change or stabilize line-pack conditions is immediately available for the dispatcher's use.
5. Any upset at compressor stations can be instantaneously noted by the dispatcher and corrective actions initiated without delays.
6. Available manpower can be put to greater and broader use where mechanical sequencing manipulations can replace personnel provided there is no valuable judgment required.

Automation Problems

Automation is not without its problems. It will introduce some new problems, and intensify old ones. The main difficulty arises out of filling the positions created by automation, which is demanding new skills in electronics, feed-back systems, computers, and instrumentation.

Companies will have to institute their own training programs to make available and devlop the newer skills which automation demands. In addition, engineering and technical schools will have to keep pace by tailoring their curricula to meet the new scientific theories promulgated by automation.

The speed with which any company can adopt automation will depend largely on the number of men trained in its modern ideas, and how to maintain precise equipment. In many instances, problems will be more pronounced at old established management levels. Companies will have to train executives to clearly grasp the potentials of new automation systems and acquire fresh attitudes demanded by the latest techniques.

There is no need for any great displacement of personnel. Available employes can be trained to operate and maintain control systems. There will be a greater trend toward specialization, with the ratio of supervisors to employes decreasing.

Design for automation . . . The second problem of automation is that it will be difficult, and in most cases completely uneconomical and unsuitable to adopt automatic operation to existing plants. A plant, to be automatic, must be designed with the idea from the start. It cannot be constructed with the thought that at a later date, a shift to automatic operation can be made, awaiting the outcome of someone else's experiments and experiences. To make such a change would show total disregard of costs.

Although there are many fine fundamental sensing instruments available on the market, much basic instrument work is still required. Many sensing instruments lack the reliability and accuracy essential for control systems. The secondary systems which gather, receive, and transmit information are in stages of higher development and dependability than the basic sensing instruments.

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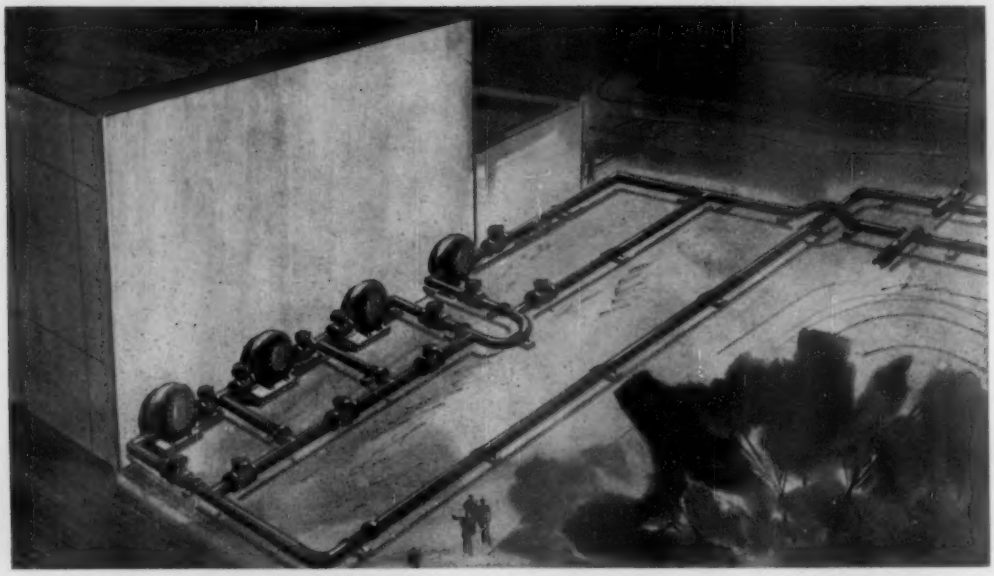
of the stations will be carried out by the shift operators.

Control circuits . . . The control circuits from Nashville to each automatic compressor station and the transport measuring locations will consist of single telegraph lines, furnished by the Bell Telephone System. Nashville was selected as the pipeline operational and control center because:

1. It is located near the geographical center of the pipeline.
2. Nashville is the major Bell Telephone System communications hub for the south-central part of the country.
3. Nashville provides the shortest and least expensive overland control circuit routes to each centrifugal station.
4. The chances of a total control circuit outage are reduced by having line facilities both north and south out of Nashville.

Safety and security . . . Great emphasis has been placed on the safety and security of the automatic stations. The engines, auxiliary, and control equipment will be housed in concrete structures. A 12-in.-thick concrete fire wall will separate the engine room from the compressors and high-pressure gas piping. The centrifugal compressors and all high-pressure gas piping are located outside the engine room. The engine room has no openings other than those required for piping, conduit runs, and for forced ventilation purposes.

The concrete fire wall is designed to withstand a force of 65 lb. per sq. ft. and will resist the damaging effects of



CENTRIFUGAL COMPRESSORS and all high-pressure gas piping are located outside the engine room.

high-pressure gas fires and explosions. The auxiliary and main engine rooms are equipped with three independent fire-sensing systems. Each device is able to immediately detect a fire. Two systems when activated will shut down the compressor station, blow down the yard gas piping, and place in service a 1,600 g.p.m. fog system. In addition, the engine room will be tested for the presence of an explosive mixture every 2 minutes. Should the analyzer sense the existence of an explosive condition, the entire plant is immediately shut down until the difficulty is corrected. Each station has an automatic remote control shutdown system, whereby station personnel can shut in the plant from remote locations on the site.

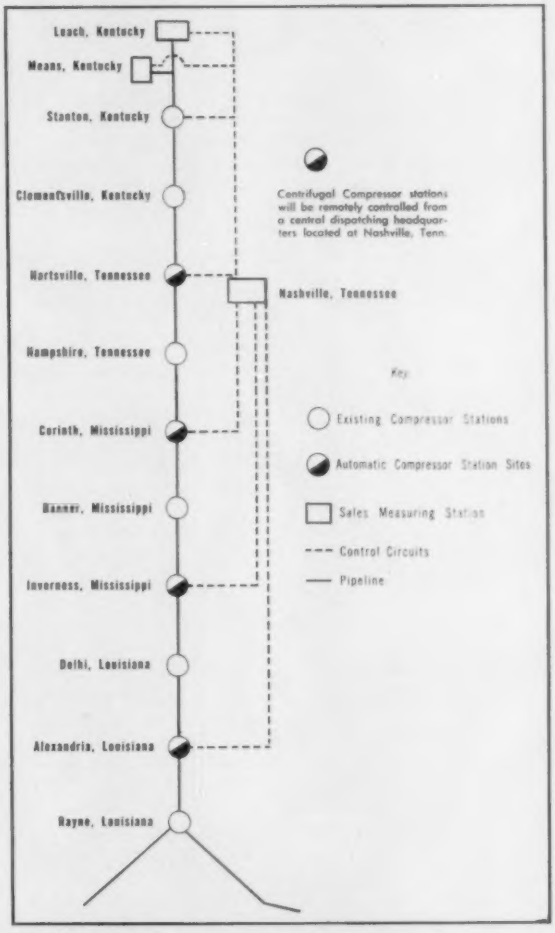
Feed-back systems . . . The most important selection when designing a remotely controlled station is the type of feed-back system which is selected. The system has to be foolproof, and cannot be affected by stray signals or faulty information. When an order is given a receiving station has to know that the transmission of the signal is correct before executing the order. Gulf Interstate, after reviewing many types of feed-back systems, selected a code method developed and manufactured by the Union Switch and Signal Division of Westinghouse Air Brake Co.

A code system transfers information from one location to another by applying a series of characterized pulses on a line circuit. Each pulse represents one piece of information. A code system counts the pulses, identifies each pulse as to its position in the code, and gives each pulse a character. Each pulse is registered at the receiving location. False or incomplete pulses will not register or be received. The pulse method is truly a foolproof feed-back system.

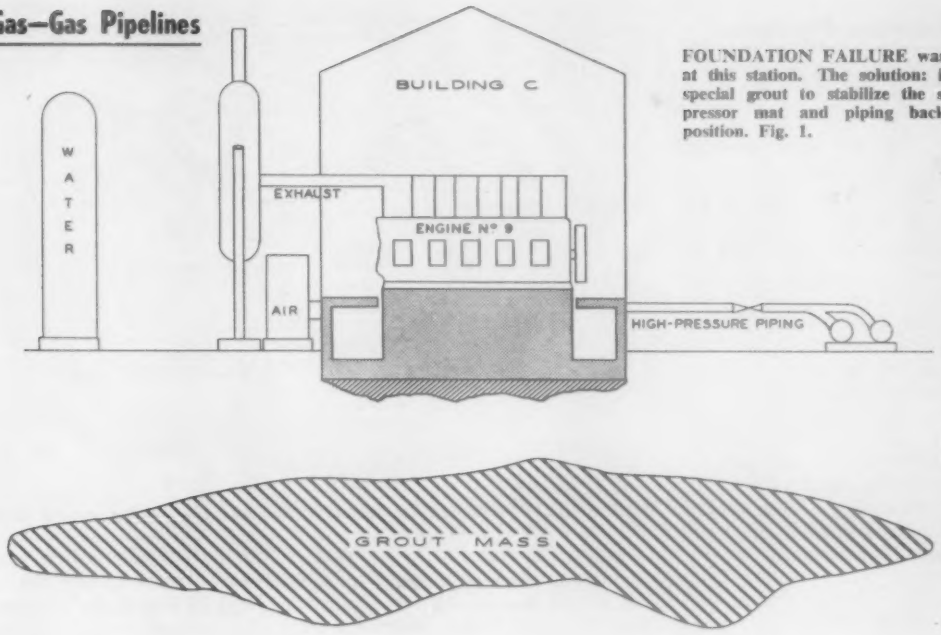
The gas industry should not hesitate to use a highly mechanized and automatic equipment to better its competitive position. As we all realize, automation cannot be adapted to all phases of the gas industry. It can, however, in chosen areas of gas-transmission efforts, help the industry to stay ahead of other energy supplies. It is available for the gas industry to use. Whether the gas industry uses it or not, it is certain other energy industries will.

Reference

1. Data Telelogging in Pipelining, by Arthur P. Jackel, Union Switch and Signal Division, Westinghouse Air Brake Co. The Oil and Gas Journal, 55, No. 2, p. 112, January 14, 1957.



AUTOMATIC control arrangements of Gulf Interstate. Single teletype circuits are to be furnished by the telephone company.



FOUNDATION FAILURE was the problem at this station. The solution: injection of a special grout to stabilize the soil, lift compressor mat and piping back to original position. Fig. 1.

Needed: More Knowledge on . . .

How to Design Stable Compressor Foundations

Study of soil mechanics might provide some answers

by Thomas L. Novosad

COMPRESSOR foundation design is still far from foolproof. While in most instances conventional design methods have been satisfactory, there have been many cases where they have fallen short. Some of the factors that fall under the science of soil mechanics need further development before the gamble is completely taken out of compressor foundation design.

Experiences and tests on some of the Tennessee Gas Transmission Co.'s installations have indicated that present design methods do not assure a nonvibrating structure. In the past, T.G.T. has used most of the standard engineering methods in designing compressor-station foundations. A few unfortunate occurrences showed the need for more design information and better design techniques.

Excessive vibration caused some foundation failures. This is not exactly novel, as other writers have pointed out. However, these occurred despite use of sound engineering principles in design. Question one: Is something being overlooked or neglected in current design practices? Usual practice is to base designs on static bearing tests. The soil loading has been held around 1,000-1,500 lb. per sq. ft., which results in a safety factor of two or better. Question two: Can a compressor foundation be viewed only in the light of static loading? An inquiry into the

Author is research engineer, Tennessee Gas Transmission Co., Houston.

The author says . . .

Good foundation sites should be carefully sought out prior to construction. Even in swampy or marshy areas, a search may reveal a soil structure suitable. Good sources of information are the U. S. Corps of Engineers, the Agriculture Department, and local experience. Soil-resistance surveys, along with seismic tests, may be a quick way to make preliminary surveys. When the search has been pinpointed, bore holes certainly give direct information.

Further work should be done in determining the action of piling under dynamic load. More accurate methods should be worked out to define conditions that cause vibration and methods to control them. More study is needed to bring out better compressor foundation structures using the available materials most efficiently. The core of the problem—engine unbalance—should be investigated.

theory of vibration may hold some of our answers.

Vibration . . . Causes of vibration can be boiled down as follows:

. . . Unbalanced forces and couples inherent in the engine.

. . . Soil characteristics at station site.

. . . Construction design with respect to reducing vibration.

Reasons for engine unbalance will not be discussed. These forces vary greatly depending on design. They are considered to be either at engine speed (primary) or twice engine speed (secondary). In both cases they may be vertical and horizontal. Couples are also present which act parallel to the axis of the crankshaft at both primary and secondary frequencies. These couples also result in horizontal and vertical forces.

The necessity of having to accept engine unbalance lies at the core of any foundation-vibration problem. Where troublesome soil conditions are unavoidable, engines having low unbalance should be installed. The designer should also make this condition known to the manufacturer. In some cases he can rearrange counterweights or compressor arrangement to make the unbalance acceptable.

Foundation Failure

An example of foundation failure was experienced by T.G.T. in the Mississippi River Alluvial Basin. This station consisted of three separate compressor buildings—A, B, and C. Building A had been in operation about 8 years before failure and building C about 2 years. No failures occurred in building B.

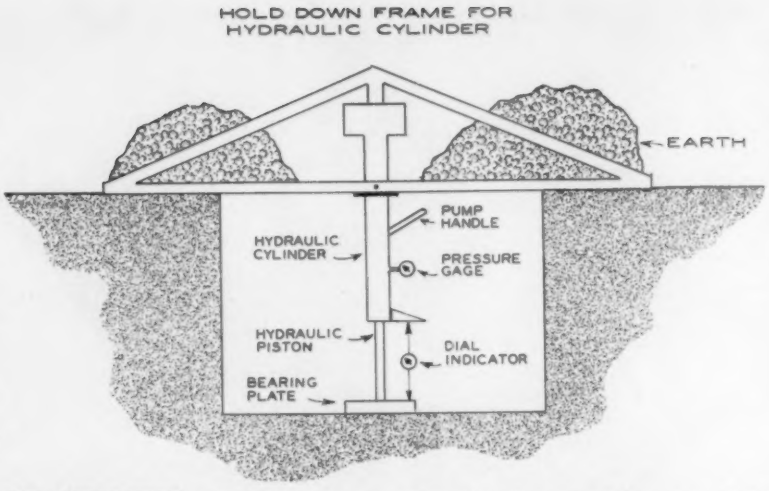
About 4 months prior to failure, a compressor arrangement change was made on each unit in building A. Three new engines were installed at building C. The new units operated at 2,000 b.hp. and 250 r.p.m. as against 1,000 b.hp. and 300 r.p.m. for the old units. First indication of failure came as the foundation began settling at the center of the three units. This continued for about 8 months during which time the foundation settled over 3 in. Building A also began to settle about the same time and it dropped 2½ in. during this time. Throughout this period, close inspections were made of the high-pressure piping. Flanges were unbolted to determine builtup stresses and levels were kept on sensitive points to check them against stable references.

How it was solved . . . Two courses of action were taken to solve the problem; both were directed at stabilizing the foundations and then lifting them back to their original positions, if possible. The engine manufacturer was called in first. His part was to determine what could be done to reduce the engine unbalance. It was found that a change in compressors on the units in building A had caused a large increase in the horizontal primary unbalance. The old compressor system was reinstalled. Also, engine counterweights in the new units at building C were rearranged. Engine unbalances in both buildings were greatly reduced. This in itself might have been enough to prevent further settlement. However, this could not be risked and some means of soil stabilization was deemed advisable. A contracting firm was brought in to attempt to stabilize the soil and possibly lift the compressor mat and associated piping back to its original position.

A soil survey showed that a zone of soil instability had developed from 10 to 40 ft. below the foundation mat. Remote corings indicated that the unstable soil was limited to an area within a 70-ft. radius of the building. A special grout was injected into the unstable soil area to overcome this condition.

The grout consisted of a portland-cement base fortified with an intrusion aid. This intrusion aid acted to keep the cement particles in suspension. By this means, excess water was displaced and the soil was compacted. When the soil had become stable, injection was continued in an effort to lift the mat. This was accomplished without difficulty. A cross-section of the area affected by the intrusion material is shown in Fig. 1. The stabilization was carried on from unit 11 through unit 4. To date, there has been no more settling.

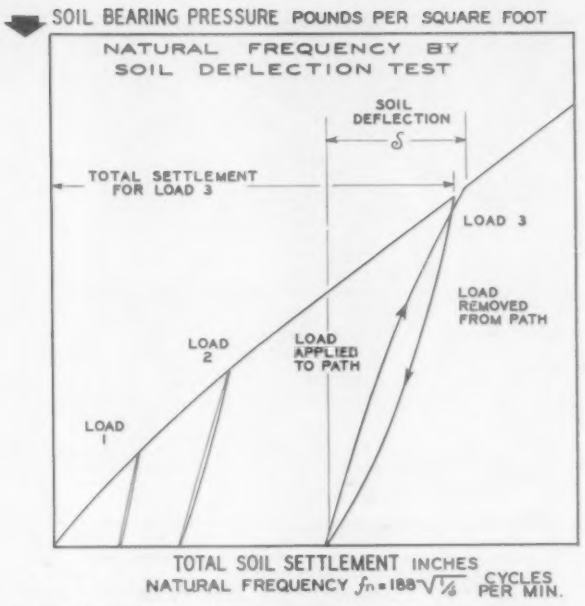
The change in counterweight arrangement proved so successful that it was tried at another station in the lower Texas coast having the same engine and, of course, the same unbalance. Vibration tests were made before and after the change by use of a special low-frequency response vibration pickup developed by Southwestern Industrial Electronics Co., Houston. This was a closely controlled test and it was possible to accurately evaluate the decrease in foundation vibration when the new counterweight arrangement was installed. Ground shake could be easily measured at some distance from the plant. The change here was a sufficient remedy and again points out the importance of selecting low unbalanced engines for such locations.



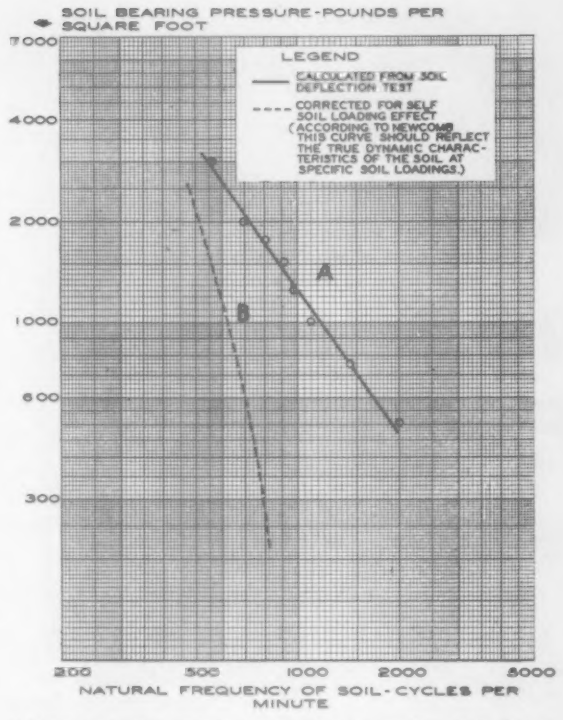
SOIL DEFLECTION test equipment is one means of testing natural frequency of the vibrating system. Fig. 2.

Other problems . . . Unfortunately, injection of grout is not the answer to all bad foundation problems. Shortly after the foregoing incident, the intrusion process was tried at a station equipped with horizontal twin tandem 1,600-b.hp. units operating at 125 r.p.m. This station was experiencing horizontal vibration perpendicular to the long axis of the building. This caused occasional failure of structural parts of the building. Injection was attempted by boring holes through the mat and pumping the grout under the foundation. The nature of the soil prevented penetration and the method proved of no use here.

Vibration can still occur on well-supported foundations. One station located close to the Mississippi River has its foundation supported on piling. Seventy-foot piling was driven down through the river silt which extended to a depth of at least 170 ft. The foundation is a mat type of construction and no serious settlement has been reported to date. However, the station is still subject to severe foundation vibration and the mat and foundation



TEST RESULTS are shown for different loads. Calculations for natural frequency are made. Fig. 3.



NATURAL FREQUENCY is plotted against load applied. Fig. 4.

blocks have failed in numerous places.

A review of the literature on methods to prevent engine foundations from vibrating shows that the subject has been studied by many.[1] However, most solutions are not complete due to certain oversimplifications. This makes the use of present design methods still subject to possible failure.

T.G.T. now follows a program of spaced borehole drillings at all new station sites. Soil samples are analyzed at various depths and soil-bearing load tests are made. The resultant information has greatly reduced the probability of a foundation failure.

Soil Dynamics

One important factor in designing foundations is the "natural frequency" of the vibrating system which is the soil, foundation, and engine. The natural frequency is the frequency in cycles per second at which the system will vibrate, if, for example, the foundation and engine are displaced by some force and then the force suddenly released. It is important in foundation design because when the engine unbalance (either primary or secondary) is at the same frequency as the natural frequency, extreme vibration is generated. Most designers try to keep the frequency of major unbalance less than half of the natural frequency. There are three methods of test whereby the natural frequency may be found:

1. Calculation from static deflection by the equation

$$f_n = 188\,(1/\delta)^{1/2}$$

f_n = undamped natural frequency in cycles per second (c.p.s.)
δ = static soil deflection in inches

. . . **Impact**—such as using dynamite or hammer blow. The earth is set into oscillation and the frequency measured represents the natural frequency.

. . . **Induced oscillation** by use of a mechanical oscillator driven at various frequencies. The one giving the largest earth vibration is taken as the natural frequency.

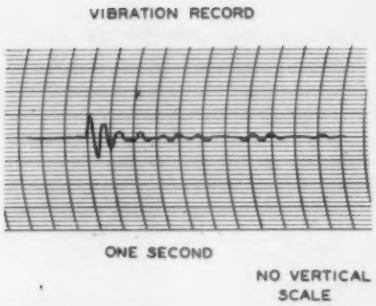
Soil deflection . . . The soil-deflection method is not accepted as very accurate since it depends on static loading. However, we tried it at a new station site near the Mississippi River. The results did not correlate with the impact tests to be described. The test equipment consisted of a 1-sq.-ft. bearing plate placed on the soil at the same level as the bottom surface of the mat.

Pressure was applied by using a hydraulic cylinder weighted down by earth loading. Readings of deflection were taken from a pressure gage, attached to the hydraulic cylinder, calibrated in rounds per square foot. A diagram is shown of the setup in Fig. 2. A dial indicator was used to read soil deflection under the load applied. Data were obtained for different loads as the chart in Fig. 3 shows. Calculations were made of the natural frequency by using the equation given above. With increasing loads the deflection will increase, bringing the natural frequency down.

Natural frequency may be plotted against its respective load on log paper as shown on curve A in Fig. 4, which represents the results of one of the T.G.T. tests. It is recommended that this curve be corrected to better represent the results expected from dynamic tests as shown in curve B.[2] Generally, this correction makes the curve lower. From Fig. 4, it is apparent that at a soil loading of 1,100 lb. per sq. ft. (approximately the design load) the natural frequency would be 600 c.p.m. or 10 c.p.s. This is the same as the secondary unbalance of the units to be installed, and severe vibration could be expected.

Impact . . . The impact method was tried next. This method has been used by other investigators.[3] The test was made before and after the foundation was constructed. This would give results for unloaded and loaded conditions on the actual foundation, whereas the soil-deflection method is based on a 1-sq.-ft. area.

An electrical vibration pickup was used to sense the oscillation created by the impact. A Brush electronic amplifier and direct-writing recorder was used to record the vibration. Dynamite was used to create the necessary impact in shot-hole depths of 15 to 21 ft. The vibration pickup was placed 80 to 100 yd. away from the point of impact.



VIBRATION IS TESTED by impact method. Fig. 5.

In all, seven shots were made with results as follows:

TABLE 1—RESULTS OF FIRST IMPACT TEST

Shot No.	Major frequencies noted (c.p.s.) Vertical	Horizontal
1	5-7.5	5-7.5
2	5-7.5	
3	7.5	
4	6.25	7.5
5	7.5	7.5
6	Void	Void
7	Void	Void

The recordings did not show clear-cut results as indicated by Fig. 5, which is a reproduction of the third shot. Higher frequencies were generally present in the first few cycles.

Although the records were rough, it was apparent that the frequency was lower than that found by the static-deflection method.

After construction was completed, but before operation was begun, more impact tests were run.

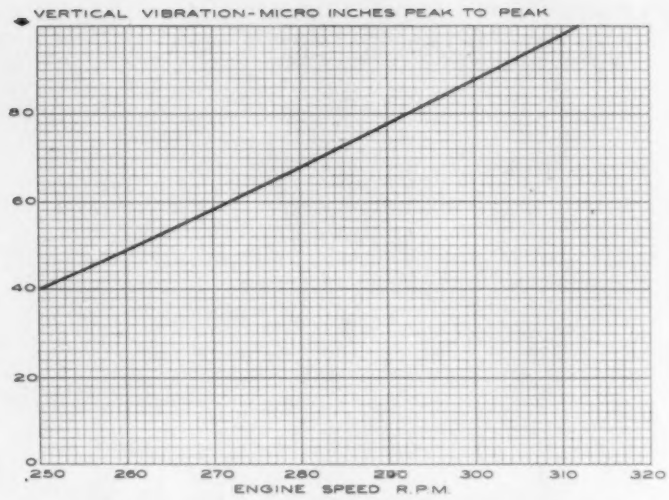
Charges of dynamite were set at 12-ft. depths and 50-ft. distances from the compressor mat, perpendicular to its axis. The mat was constructed on creosoted wood piling. There were forty 14-in. butt piles per unit, which were driven to refusal. The concrete mat was cast around the top of the piling to a depth of 1 ft. and had a thickness of 3 ft., a width of 40 ft., and a length of 230.5 ft. The foundation was built for nine compressor units.

The results of this impact test were as follows:

TABLE 2—RESULTS OF LATER IMPACT TEST

Shot No.—	Major frequencies noted (c.p.s.) 1st part of oscillations	2nd part of oscillations
1—East side	17.5	7.5
2—East side	17.5	7.5
3—West side	17.5	5-6.7
4—West side	17.5	7.5

These tests again brought out the possibility of a low frequency of around 7.5 c.p.s. The 17.5 c.p.s. were present for at least the first five cycles of oscillation; then the 7.5 c.p.s. came usually for not more than two cycles, indicating a high damping. The trailing oscillations were then so complex that no major frequency could be determined. From this data and other investigations, it is clear that the elastic systems of earth, foundation, and engine can respond to several frequencies.[3,4]



VERTICAL VIBRATION increases with engine speed. Fig. 6.

Because of the condition of the soil, special care was taken in choosing engines which had low vertical unbalance. The units were turned so that their crankshafts were perpendicular to the long axis of the mat. After operation of the plant was begun, vibration was very low, being in the order of 0.0001 in. peak to peak. One unit was tested through a range of speeds from 250 to 310 r.p.m. Vibration increased as shown in Fig. 6.

Oscillation . . . One other method for finding natural frequency should be mentioned. This is done by forcing the earth to oscillate by use of a mechanical oscillator.[4] The speed and unbalance force can be controlled while the unit is running. The method of test is to operate the oscillator through a wide range of speed and in such a way as to control the force transmitted to the earth. This method would be ideal if its contact area and weight were as large as the actual compressor foundation. Actual test units have a contact area of only a few square feet.

This presents the problem of how to extrapolate the data obtained to the expected natural frequency of the much larger earth—foundation system. Tschebotarioff and Ward[5] have given a way by which this may be done by the use of a reduced natural frequency test: natural frequency × soil load per square foot is plotted against area of test on log-log paper. A curve may be drawn through the points.

Data obtained by the use of oscillators have shown that harmonics and subharmonics of the natural frequency may be excited.

Piling vibration . . . The use of piling brings in another problem when determining natural frequencies. One of the case histories discussed above points out that piling foundations can give trouble from a vibration standpoint. The natural frequency was calculated, based on the assumption that the wooden piles were held tightly at the top of the mat and that the bottom one-third was tightly imbedded in the earth and two-thirds was loose to deflect. The result was a natural frequency of 10.23 c.p.s.—very near the secondary frequency of the engines installed at this station. If the above-calculated results are correct, then this installation would have been better off with concrete or steel piling.

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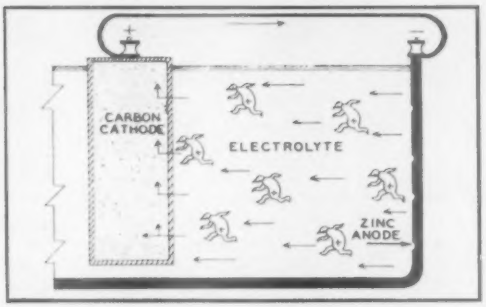
2. Newcomb, W. K., "Principles of Foundation Design for Engines and Compressors," A.S.M.E., Trans., Vol. 73, pp. 307-312; Discussion, pp. 313-318, 1951.

3. Crockett, J. H. A., and Hammond, R. E. R., "Dynamic Principles of Machine Foundations and Ground," Institution of Mechanical Engineers, Proceedings, Vol. 160, pp. 512-531, 1949.

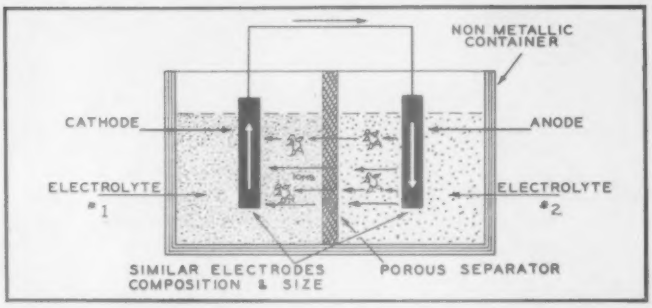
4. Bernhard, Rudolf K., "Geophysical Study of Soil Dynamics," A.I.M.E., T.P. No. 834.

5. Tschebotarioff, G. P., and Ward, E. R., "The Resonance of Machine Foundations and the Soil Coefficients Which Affect It," Second International Conference on Soil Mechanics and Foundation Engineering, Proceedings, Rotterdam, June 21-30, 1948, Vol. 1, pp. 309-313.

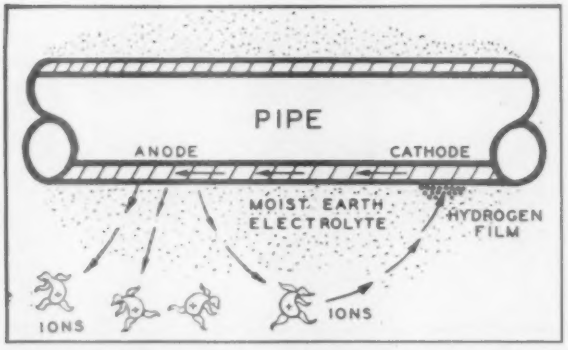
6. Shepard, E. R., Subsurface Explorations by Geophysical Methods.



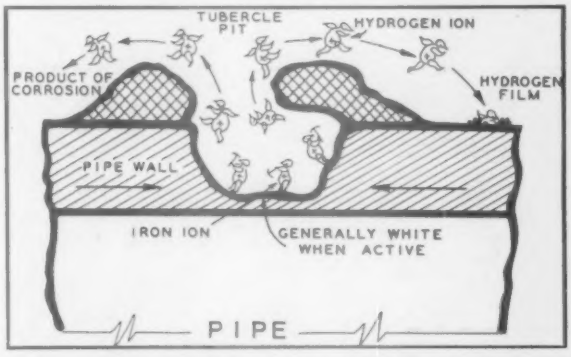
1 GALVANIC CELL is set up when two dissimilar metals, separated by an electrolyte, are connected.



2 SIMILAR METALS, surrounded by dissimilar electrolytes and connected by a wire, will also have electric current flow from anode to cathode.



3 PIPE GALVANIC CELL can be formed, with the moist earth being the electrolyte, two pipe areas, the anode and cathode, and the pipe, the connecting wire.



4 THE PIPE CORRODES at the anode of the cell. As current leaves the pipe surface, it carries with it small particles of metal called ions.

Here's Why Underground Pipe Corrodes

You can fight this enemy if you know how it works

UNDERGROUND corrosion of pipelines is responsible for much of the maintenance cost in line operation. This corrosion usually occurs as the result of formation of galvanic cells along the lines. Here in simple sketches is a brief outline of how these cells are formed and how much corrosion may be mitigated.

A galvanic cell is set up when two dissimilar metals, separated by an electrolyte, are connected to a conductor. Perhaps the simplest type of galvanic cell is the flashlight battery (Fig. 1). The metal, zinc, is used in the battery case, and a carbon rod as the center electrode. The space between is filled with an electrolyte. This is a current-conducting material.

Electric current flows from the zinc into the electrolyte, carrying particles of the zinc with it. These particles are called ions. As soon as they are dissolved in the electrolyte, they are exchanged for ions of hydrogen. The ion flow, or electric current, is through the electrolyte to the carbon rod. Here the hydrogen ions are deposited on the surfaces of the carbon rod as hydrogen gas.

A cell is also set up when two **similar** metals are separated by dissimilar electrolytes and connected by a conductor.

In any galvanic cell, the electrode from which current flows into the solution is known as the anode and will be destroyed by the current flow. The other electrode is called the cathode.

Pipeline cells . . . The galvanic cells which cause pipeline corrosion work in the same manner as these simple cells. The actual mechanisms may be more complicated, but the principles are the same.

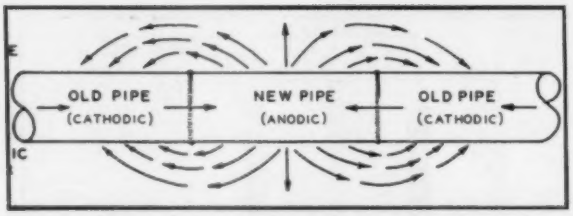
Anodes and cathodes along the surface of the line are located by making a potential survey. Usually the copper sulfate electrode is used. The electrode is placed on the surface, over the line, and is connected to one terminal of a high-resistance voltmeter. The other terminal of the meter is connected to the line, as shown in Fig. 12. An earth current meter is used to determine the intensity of the action.

Stray currents from nearby electrical systems can cause extremely rapid corrosion, and proper precautions need to be taken.

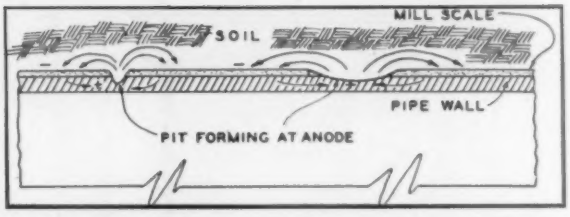
Controlling corrosion . . . Corrosion may be controlled by coating the pipe, by cathodic-protection systems, and, in the case of stray-current corrosion by preventing current leakage from the pipe.

Figs. 13 and 14 show common methods for preventing stray-current corrosion, while Figs. 15-20 show cathodic-protection systems. Some of these systems use rectifiers and ground beds, while others use sacrificial anodes.

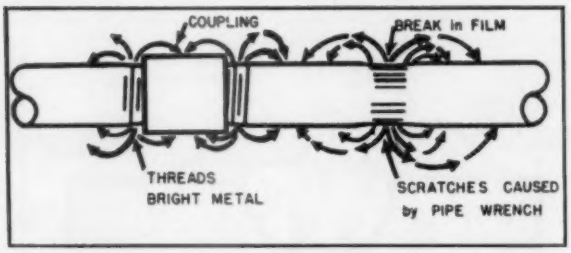
Material from A Manual on Underground Corrosion by Columbia Gas System Corporation.



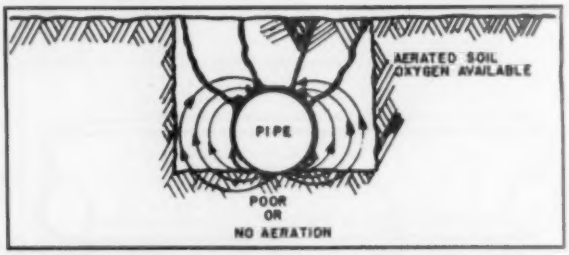
5 A SECTION OF NEW PIPE will often result in the formation of a corrosion cell. The new pipe becomes the anode; the old pipe, the cathode.



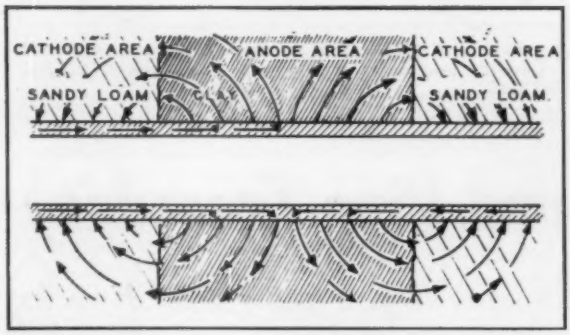
6 ANOTHER TYPE OF CELL occurs on surface of new pipe. During manufacture, particles of mill scale are imbedded. They act as dissimilar metal.



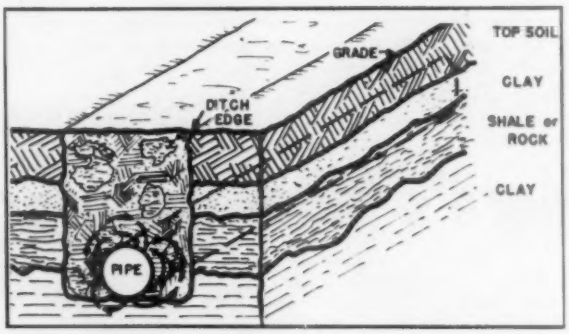
7 DIFFERENCES IN SURFACE of the pipe metal give rise to corrosion cells. Scars, scratches, and bright metal adjacent to couplings become anodes.



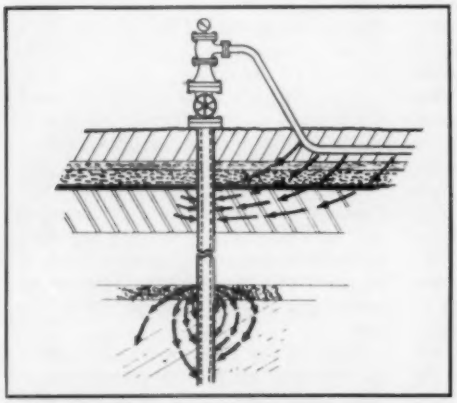
8 SEVERE PITTING can be caused by this galvanic cell of the dissimilar electrolyte type. Fill is uniform, but pipe rests on heavier, moist soil.



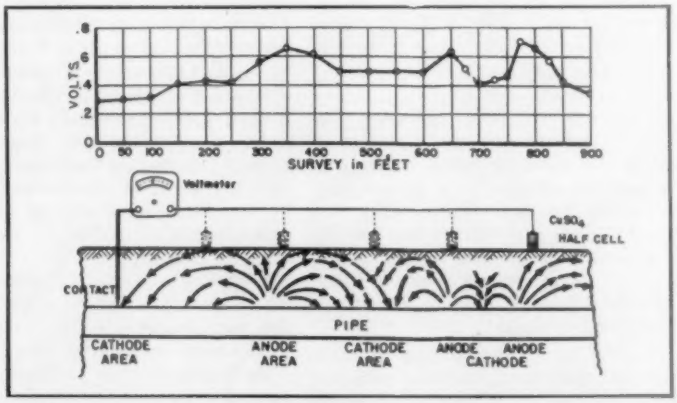
9 DIFFERENT SOILS also cause galvanic cells of the dissimilar electrolyte type. Here, one section of line is in sandy loam; the other is in clay.



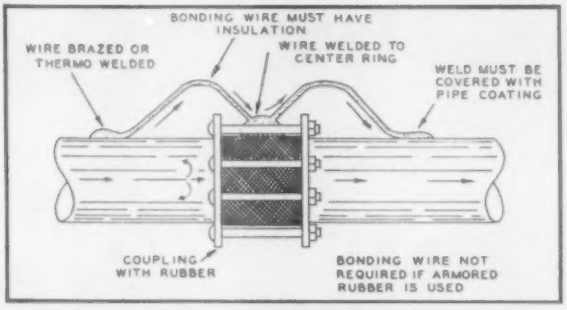
10 ANOTHER GALVANIC CELL is caused by mixture of different soils. Where large clods of clay touch the pipe, a cell anode usually forms.



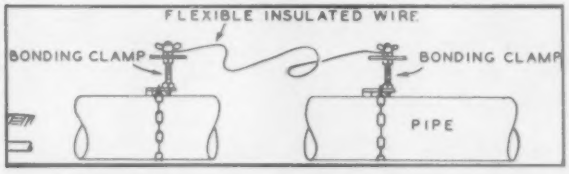
11 PRODUCTION PROPERTIES may also have galvanic cells. Casing and tubing go through many different soils in reaching producing sand.



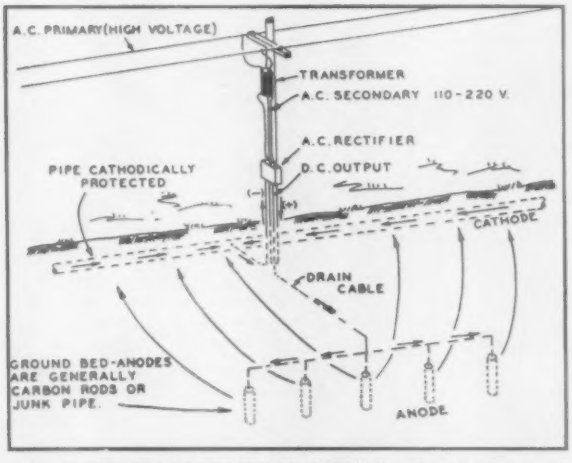
12 COPPER SULFATE ELECTRODE tests are made at 50-ft. intervals. Values obtained from high-resistance voltmeter are plotted along profile chart as shown.


BONDING WIRE MUST HAVE INSULATION
WIRE BRAZED OR THERMO WELDED
WIRE WELDED TO CENTER RING
WELD MUST BE COVERED WITH PIPE COATING
COUPLING WITH RUBBER
BONDING WIRE NOT REQUIRED IF ARMORED RUBBER IS USED

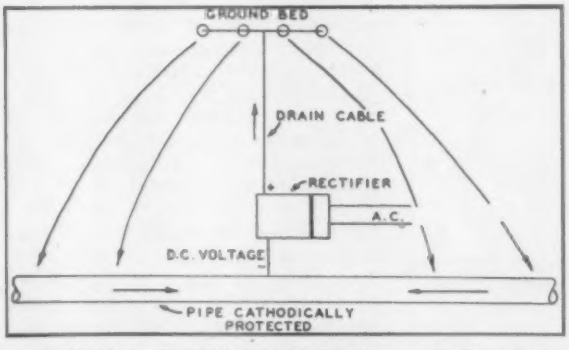
13 **STRAY-CURRENT CORROSION** can be mitigated by preventing current leakage at couplings. An electric path around coupling keeps current in the pipe.



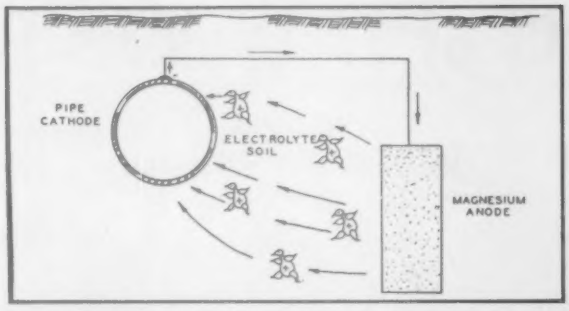
14 **LARGE CURRENTS** may flow along lines in some areas. These clamps, connected by heavy wire, are attached on either side of a coupling before opening.



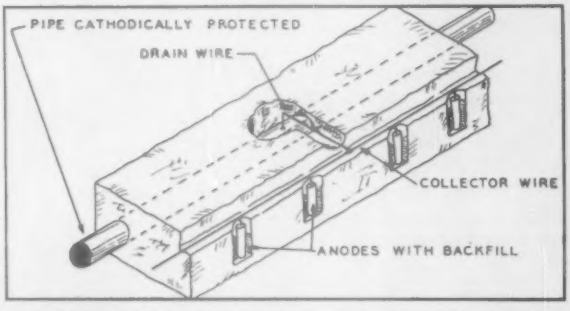
15 **CATHODIC-PROTECTION SYSTEM** using rectifier and ground bed. The flow of current onto the line keeps the galvanic cells along the line inoperative.



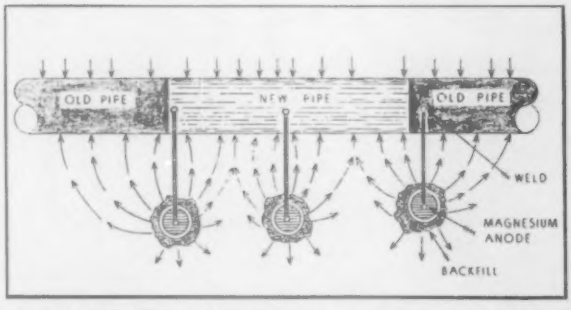
16 **TYPICAL WIRING DIAGRAM** for a cathodic-protection system. Current flows from ground bed onto the pipeline. It's drained off the line to the rectifier.



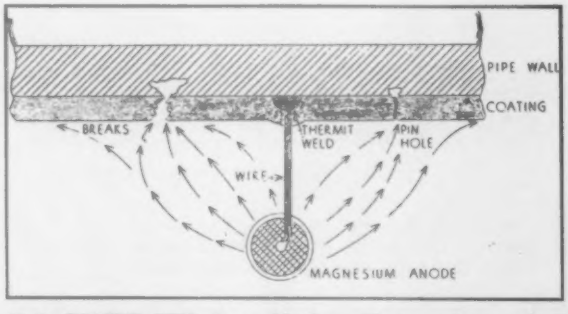
17 **CATHODIC PROTECTION SYSTEM** using galvanic anodes. Magnesium is usually used as the dissimilar-metal sacrificial anode. This suppresses galvanic cells.



18 **MULTIPLE ANODES** in series are used to protect comparatively long stretches of line. Collector line is connected to the pipe at proper intervals.



19 **MAGNESIUM ANODES** may be used to protect old and new pipe after a new section has been installed in an existing line. Two or three anodes are used.



20 **COATED PIPE**, in combination with magnesium anode is effective. The anodes prevent corrosion at breaks and pinholes. Coating protects most of the pipe.

15 of 17 Welders Flunked Tests

Close adherence to latest A.P.I. standards will eliminate most of misunderstanding and failures on operator-qualification tests

by Jerry Hinkel

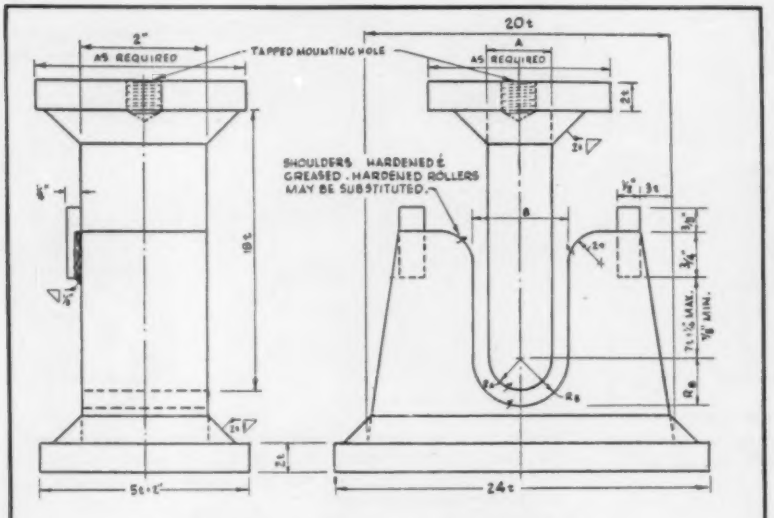
IN recent years, there has been a wholesale transition from the use of low-tensile A.P.I.-5L pipe to the higher-tensile A.P.I.-5LX, grades X-42, X-46, and X-52 pipe. This changeover has been practically 100 per cent in overland installation of gas and oil-transmission lines. This trend will unquestionably continue because the higher strength of this material permits a substantial reduction in wall thickness, and this has effected substantial reductions in material costs.

These higher-tensile steels differ appreciably in chemistry and physical properties from the A.P.I.-5L, grades A and B, which have been used extensively in the past (Table 1). These differences made it necessary to modify the weld-test requirements and also the welding procedures.

Author is application engineer with Lincoln Electric Co., Cleveland.

TABLE 1—COMPARISON OF PHYSICAL PROPERTIES OF A.P.I. 5L PIPE AND THE NEWER HIGH-TENSILE GRADES X-42, X-46, AND X-52

Steel pipe—	Yield strength min. psi.	Tensile strength min. psi.	Elon. min. per cent in 2-in. (⅞ and thicker)
Seamless Grade A: Open Hearth	30,000	48,000	35
Grade B: Open-Hearth or Bessemer	35,000	60,000	30
Butt Welder Bessemer	30,000	50,000	
Grade X-42	42,000	60,000	25
Grade X-46	46,000	63,000	22
Grade X-52	52,000	66,000	20



GUIDED-BEND TEST JIG DIMENSIONS

		PIPE GRADE X42*	X46	X52
RADIUS OF PLUNGER	R_A	3t	3½t	4t
RADIUS OF DIE	R_B	4t	4½t	5t
WIDTH OF PLUNGER	A	6t+⅛"	7t+⅛"	8t+⅛"
WIDTH OF GROOVE IN DIE	B	8t+⅛"	9t+⅛"	10t+⅛"

t = TABULATED WALL THICKNESS OF PIPE

FOR INTERMEDIATE GRADES OF PIPE, THE ABOVE DIMENSIONS OF THE BENDING JIG SHALL CONFORM TO THOSE SHOWN FOR THE NEXT LOWER GRADE OR SHALL BE PROPORTIONAL THERETO.

*NOTE: ALSO APPLIES TO ALL GRADES API 5L AND ASTM

JIG for guided-bend tests. Fig. 1.

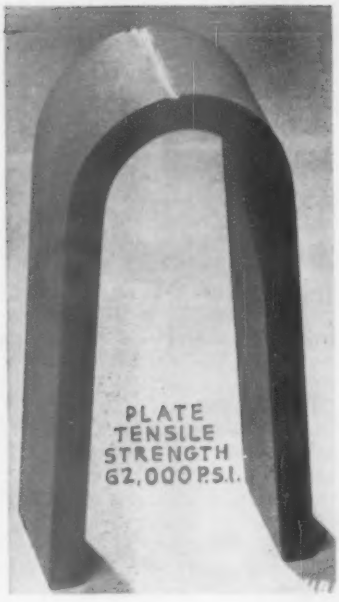
In welding low-tensile pipe, it has been a relatively simple matter to produce a welded joint which, in all cases, would exceed the tensile strength of the pipe and, at the same time, consistently meet severe guided-bend-test requirements. Both of these test requirements, tensile tests and bend tests, have been modified to suit the higher-strength, lower-ductility nature of the high-test A.P.I.-5LX line pipe.

The A.P.I.-A.G.A. joint committee on oil and gas-pipeline field welding practices has done some excellent work in studying the problems involved in arc-welding pipe, especially as they pertain to the newer high-tensile materials. This committee has kept pace with the newer materials (X-42, X-46, and X-52) and now has standards which, if carefully followed, will eliminate all of the problems which might otherwise be encountered in field welding and in operator-qualification tests.

Guided-bend test modified . . . The higher-tensile strength of A.P.I.-5LX pipe comes, of course, at the expense of lower ductility and greater notch sensitivity. Therefore, the conventional

"We continue to receive reports of situations where welders fail en masse to pass qualification tests. Not too long ago, I was talking to the inspector on the coal pipeline recently put through to Cleveland and learned that they tested over 150 welding operators in order to get 22 qualified men. The continuing difficulty has prompted us to prepare the enclosed article."

THE AUTHOR



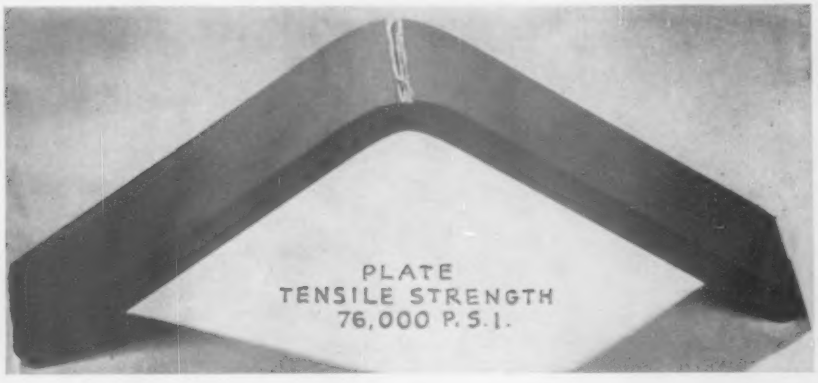


FIG 2.

THE SURFACES of these two pieces of steel were notched by machining a groove across the face prior to bending. The 76,000-psi. steel fractured on bending, and the 62,000-psi. steel bent a full 180°. The conventional guided-bend fixture (¾-in.-radius plunger) was used for this test.

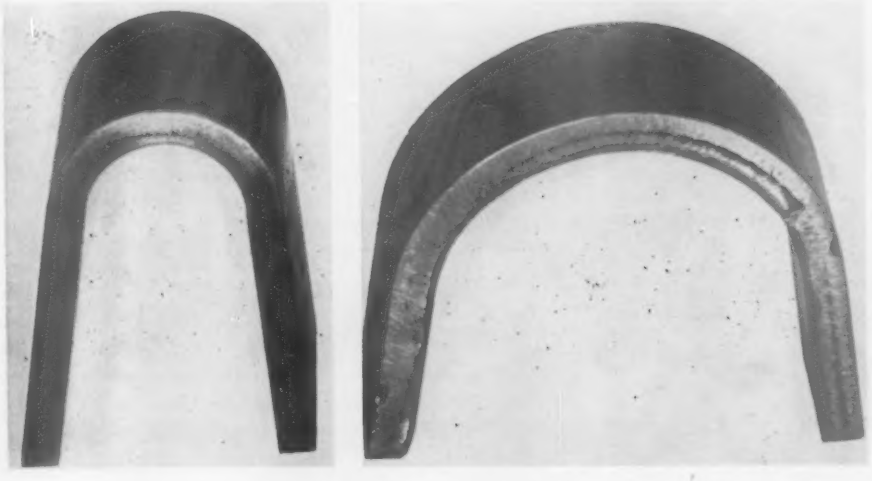


FIG. 3.

ON LOW-TENSILE pipe, a smaller radius is permissible. Left: Guided bend as required for ⅜-in. low-tensile pipe, A.P.I.-5L. Right: Guided bend as required for ⅜-in. high-tensile, X-52 pipe.

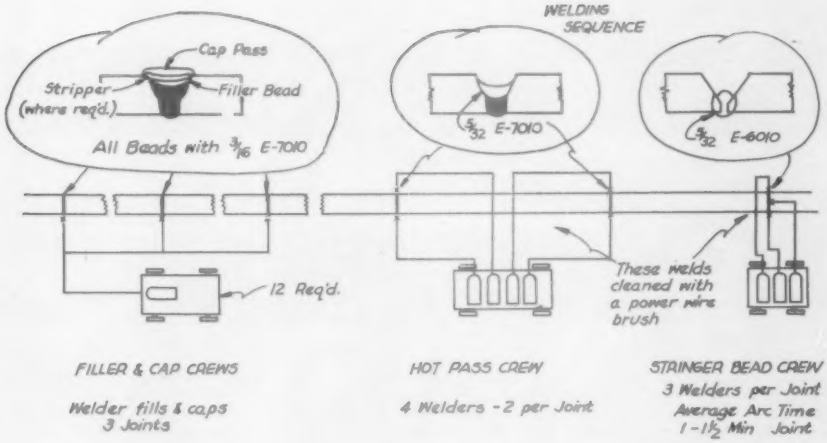
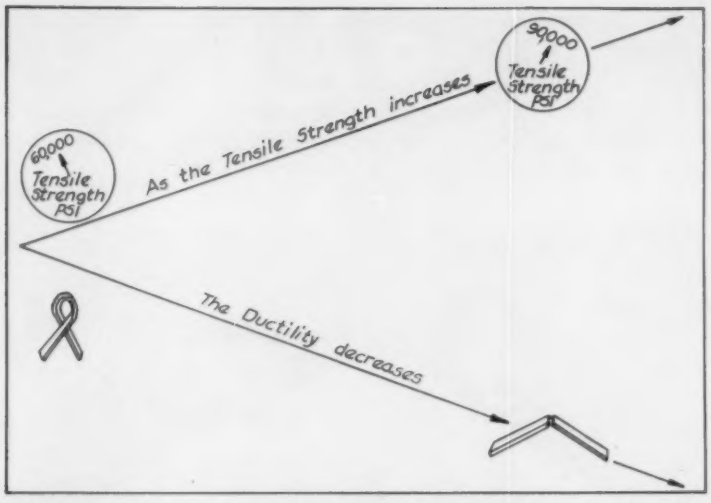


FIG 4.

A TYPICAL LINE-UP of welding crews and procedures used for a line employing high-tensile pipe.



IN CARBON STEELS, the tensile strength generally increases with the carbon content and, as the tensile strength increases, the ductility decreases. Fig. 5.

guided-bend tests have to be modified if the test is to be used as a measure of ductility. The A.P.I.-A.G.A. committee has recognized the impracticality of the old guided-bend test when used on high-tensile pipe.

Consequently, in its latest specification, Standard* 1104, Third Edition, dated March 1955, this section has been changed as follows:

"Face-bend and root-bend specimens shall be bent in a test jig having dimensions shown in Fig. 1. The specimen shall be placed with the face of the weld directed toward the gap and the root-bend specimen shall be placed with the root of the weld directed toward the gap. The plunger of the jig shall be forced into the gap until the curvature of the specimen is approximately U-shaped. The bend test shall be considered acceptable if no crack or other defect exceeding ⅛ in. in any direction is present in the weld metal or between the weld and the pipe material after bending. Each specimen subjected to the bend test shall meet the above requirements.

"(Cracks which originate along the edges of the specimen during testing and which are less than ¼ in. measured in any direction shall not be considered.)"

Fig. 1 is a diagram of the new jig.

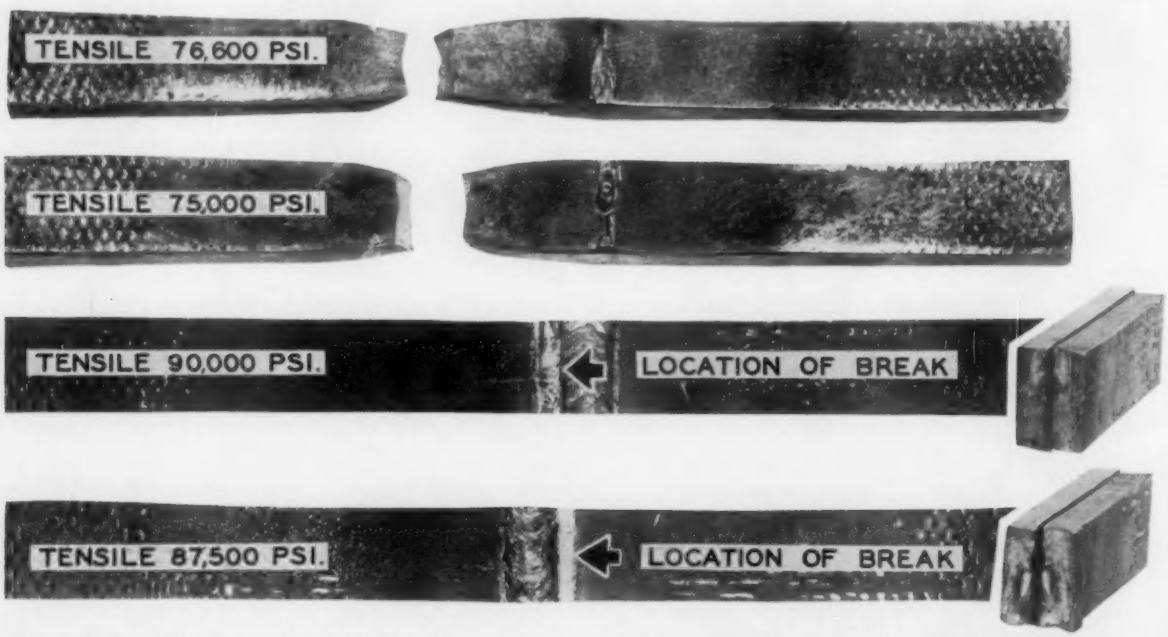
In some instances, users have ignored the A.P.I.-A.G.A. recommendations and have attempted to use the conventional guided-bend fixture. Since this fixture was designed for testing welds on low-carbon, mild steel, it is not suitable for X-42, X-46, and X-52 pipe and its continued use can only lead to large-scale failures.

When this happens, all factors are under suspicion, the operator could lose his job, the electrode is often suspected of being at fault, and the entire welding procedure is open to criticism. All of these pitfalls can be eliminated by following A.P.I.-A.G.A. recommendations. (See Figs. 2 and 3.)

The specification also clearly states that "weld reinforcement shall be removed from both faces flush with the surface of the specimen." In field practice, it has been a fairly common practice to leave the reinforcement on the specimen and attempt to bend it in this condition. With the reinforcement left on, there is considerably greater notch effect which greatly reduces the possibility of getting a satisfactory bend.

In the past, a common practice has been to require that "the weld should

*These standards can be purchased from American Petroleum Institute, 50 West 50th Street, New York 20. Price, 50 cents.



THE TWO TOP SAMPLES broke outside the fusion zone, even though the welds were imperfect. These might be considered acceptable because failure is not associated with the weld. Lower samples broke in the fusion zone and might be considered unsatisfactory by some inspectors because of the location of the break. However, the samples, according to code specifications, are satisfactory, since failure was at a tensile strength well above that required for the base metal. Fig. 6.

CB&I built Coke Drums . . .

HEART of Twin Coking Units

Four CB&I built coke drums are the heart of two identical coking plants at Union Oil Company's Santa Maria, Calif. refinery. The coke drums are each 18-ft. in diam. by 78-ft. in height and built of ASTM-A-204 plate lined with 7/16-in. Type 405 stainless steel.

The completed vessels were field X-rayed and stress relieved. Stress relieving was accomplished by creating furnaces of the structures and firing large portable oil burners into the vessels to bring them to desired heats.

CB&I's vast experience and complete facilities enable them to engineer, fabricate and erect steel plate structures to the petroleum industry's most exacting specifications. When planning structures of standard or unique design, plan with CB&I. Write our nearest office for complete information.

Twin coking units at Union Oil Company's Santa Maria, Calif. refinery. Both units are equipped with CB&I built coke drums furnished through the Bechtel Corporation.

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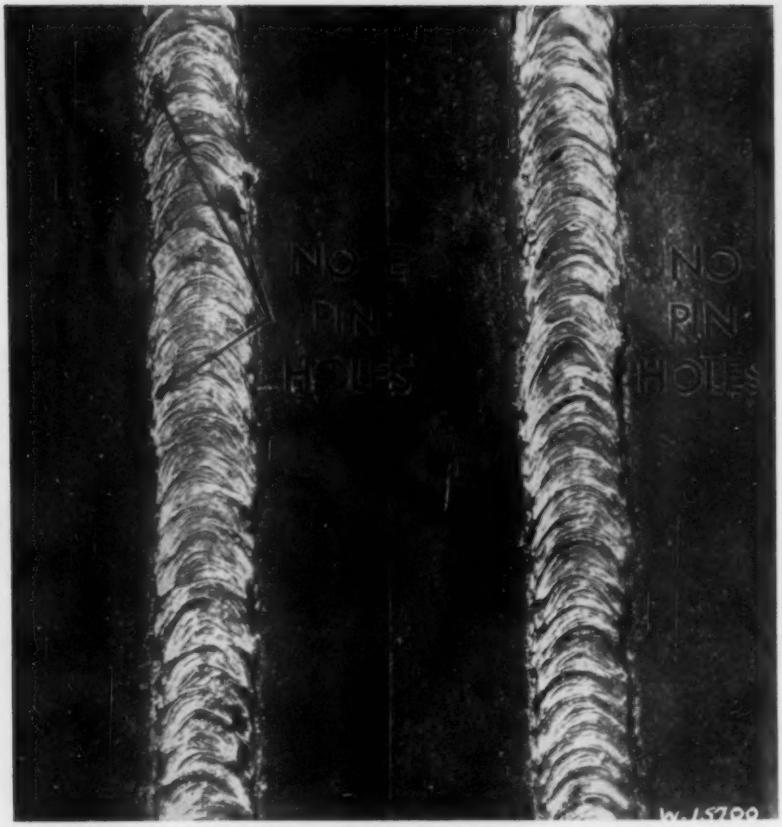


PINHOLES on the "cap pass" can be eliminated by using electrodes especially designed for the purpose and by keeping the bead as narrow as practical. Fig. 7.

beat the plate," meaning that, in every instance, the tensile coupon must break in the parent metal. Failure to meet this requirement has cost many a welding operator his job—at least until he could get a piece of lower-tensile pipe on which to run his test.

Under this system, specimens with sizable weld defects have broken in the plate simply because the plate was relatively low in tensile strength. See Fig. 4. These tests were considered satisfactory, since they did break in the plate.

At other times, perfect welds, with no defects, have broken in the weld or in the fusion zone at a value of 90,000 to 95,000 psi., and these were considered failures. In the latter case, several welding operators were disqualified.

In a majority of cases, welds made on X-52 pipe will "beat the plate" and meet the bend tests as well. But such results cannot logically be expected if the pipe itself has a tensile of 85,000 or 90,000 psi. (Fig. 5). In testing tensile coupons on X-52 pipe, tensile values as low as 72,000 psi. and as high as 95,000 psi. have been noted.

Obviously, since ductility is also a matter of concern, and ductility generally comes at the expense of lower tensile strength, it is not reasonable to expect a weld deposit which will have impressive ductility and also tensile strength above and beyond the very high values found on some of the pipe.

The A.P.I.-A.G.A. specifications cover this condition in a very realistic manner. A.P.I. Standard 1104, Third Edition, March 1955, states:

"If two or more of the specimens tested break in the weld or at the junction of the weld and parent metal, and also fail to develop the minimum specified tensile strength of the pipe metal, the welder shall be disqualified."

Comments on some typical breaks are given with Fig. 6.

The A.P.I.-A.G.A. standard for field welding of pipelines covers in detail many of the other important factors involved in good field welding practice and should be considered the bible of the industry. The modifications in testing procedure recommended by this committee, especially with reference to tensile tests and guided-bend tests, will do much to resolve the confusion and inequities which would otherwise exist in this field.

Further Standardization

While it may be beyond the scope of the A.P.I.-A.G.A. committee, there are other factors which have caused some confusion which could be minimized if not eliminated by further standardization. For example, it is generally considered unacceptable to have any "pinholes" (surface porosity) on the "cap pass" (final bead) and one can hardly argue with this decision.

However, there is considerable disagreement among field inspectors as to the permissible width of the cap pass. Some inspectors insist upon a wider bead than others, and it is a well-established fact that the wider the cap pass the more tendency there is for pinholing (Fig. 7). Also, the additional width adds nothing to the strength or ductility of the joint. Experience has shown that the narrowest cap pass is the easiest to make and is far more trouble-free.

Some discrepancy also exists as to the minimum permissible buildup. Some inspectors will require more buildup than others, and, beyond certain limits, getting additional buildup poses a real problem to the welding operator, and it is virtually impossible to show that the additional buildup does any good.

The service record of the high-tensile pipe which has been laid in recent years is very good and the prevalence of operator qualifications failures is on the downgrade. With a better understanding of the pertinent factors involved and closer adherence to A.P.I. standards for welding and testing, these failures can be eliminated. **End.**

BOOKS

CHEMICAL PROCESS ECONOMICS IN PRACTICE. Edited by J. James Hur. Published by Reinhold Publishing Corp., 430 Park Avenue, New York. 115 pp. $3.95.

This is a collection of papers originally presented under the auspices of the A.I.C.E. and University of Pennsylvania school of chemical engineering. The papers are over-all reviews of accounting, plant investment, cost of services, plant-operating costs, economic analysis, and plant financing.

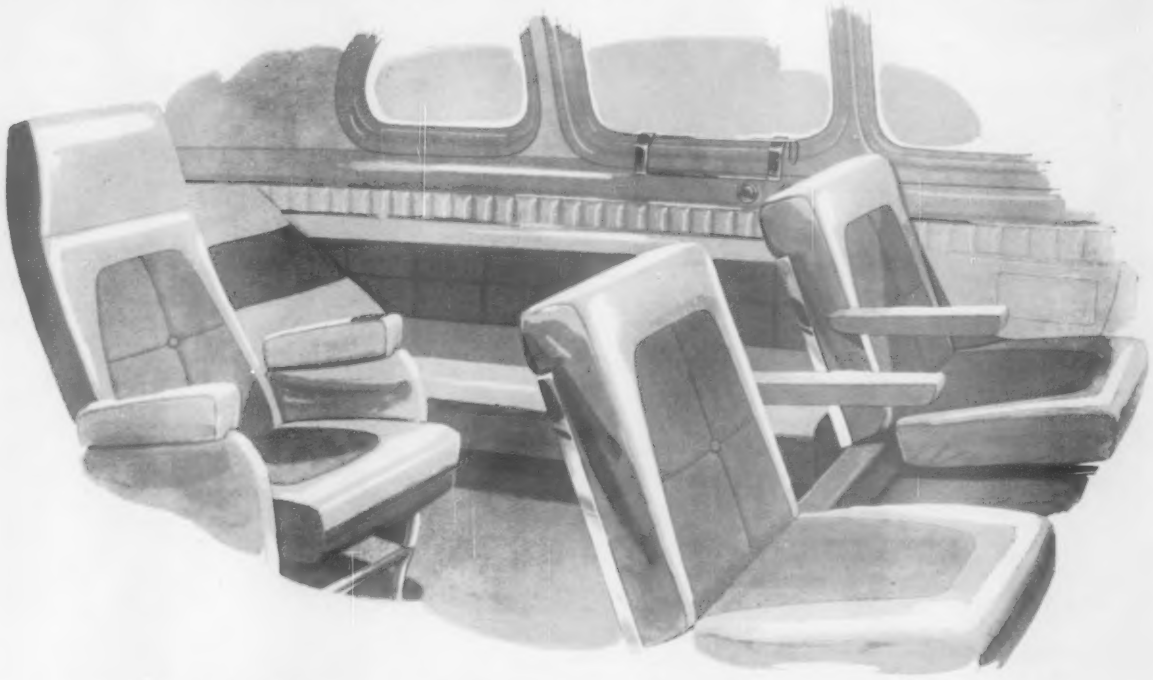
PUMP SELECTION AND APPLICATION by Tyler G. Hicks. Published by McGraw-Hill Book Co., Inc., 330 West Forty-second Street, New York 36. 422 pp. $8.50.

The biggest problem facing many engineers today is how to select and apply the best pump for a given set of conditions. The book gives a step-by-step procedure for analyzing a pumping problem. Over 400 illustrations help describe a wide range of problems and types of pumps.

Besides discussing the basic types of pumps and problems met in pump application, this book devotes a chapter to the specific pumping problems of each of a number of industries including the petroleum industry.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.

The '57 Beechcraft Twin-Bonanza – Best Ever Built!



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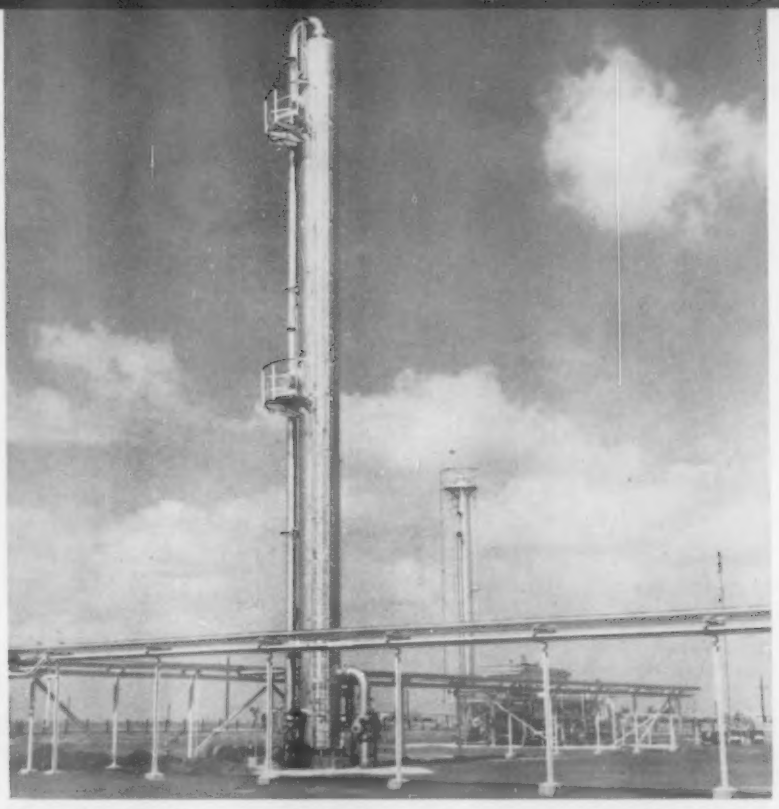


QUINDUNO FIELD booster station sweetens sour gas and compresses it for delivery to gasoline plant.

Booster 49 Tames Sour Gas

Natural Gas Pipeline installation treats 23 M.M.c.f. of sour wet gas daily at Quinduno

by L. V. Parent

A NEW phase of pipelining began on July 18, 1956, for Natural Gas Pipeline Co. of America when operations were started at Booster No. 49 in Quinduno field, Roberts County, Texas. Facilities had been installed to take 23,500,000 cu. ft. per day of sour wet gas at 25 psig., to remove condensed hydrocarbons and liquid water, to compress the gas in two stages to 290 psig., to sweeten it, and to inject the condensed hydrocarbons into the high-pressure gas stream for transportation to a gasoline plant at Fritch, Tex. All of this was done in a plant where ground was broken on April 3, just 3½ months earlier.

This plant is located in Quinduno oil field about 15 miles northeast of Pampa, Tex. The site chosen for the plant location is a 20-acre tract of nearly flat grazing land on the Haggard ranch. The gas purchased is liberated in the producers' stock tanks and delivered directly into our gathering lines. Prior to this time, the gas was flared.

To bring the gas to the plant, it was necessary to construct 19 miles of 4-in. through 16-in. gathering lines to connect the producers' tank batteries with the booster-station suction header. Inasmuch as this station is quite remote from other company installations, cottages were constructed on the property for living quarters for key operating personnel. Routine plant operations are performed by an operator and helper on each shift.

Design Factors

In the initial consideration of design, it was felt that the plant should be made as self-sufficient as possible, within economic limits. To hasten construction, the company purchased package compressors with separate cooling facilities; a semiautomatic desulfurization plant, mounted for the most part on skids; a packaged boiler for process and heating steam, and an automatic separator and blowcase for handling liquids.

To house the operating equipment, three steel-panel buildings were erected. These were the main building for the engines, the auxiliary building for the air-compressor boiler, emergency power plant, control center and water-treating plant, and a meter building for fuel-measuring and regulating equipment. The amine-regeneration plant was not housed.

Header piping and building layout are arranged for future expansion. Control equipment is electrically or pneumatically operated. Air compressors are provided for starting, service, and instrument air. One is motor driven and one is engine driven. The engine driven unit is available for service in the event of power failure. Since the power load for the station is not large enough to justify generating equipment, other than a 5-kw. unit for emergency lighting, electricity is purchased.

A unique arrangement in the control center will permit direct connection of a 25-kw., 440-volt, 3-phase portable unit which is on hand at a nearby station. In the event of a serious power outage, this unit can be moved in at a moment's notice to handle the entire operating requirements of the desulfurization plant and related equipment.

Gas treating . . . An analysis of the gas indicated that the plant must have desulfurization and hydrocarbon removal facilities.

AVERAGE GAS COMPOSITION

	Per cent
Methane	18.2
Ethane	7.7
Propane	3.6
i-Butane	0.50
n-Butane	0.9
Pentanes	0.8
Nitrogen	5.2
Carbon dioxide	0.1
Specific gravity	0.645
Gr. H_2S/100 cu. ft.	40
Heating value (B.t.u.)	1,150

Hydrocarbon removal, one of the problems, was solved by installing a separator on the station inlet line to accumulate condensed liquids. The water and hydrocarbons thus collected are automatically separated into phases, water going to drain and hydrocarbons to a blowcase for injection into the high-pressure plant discharge line. Pneumatically operated level controllers can dispose of as much as 2,400 bbl. of fluid per day. Should the liquid level in the separator get too high, an alarm light goes on in main building.

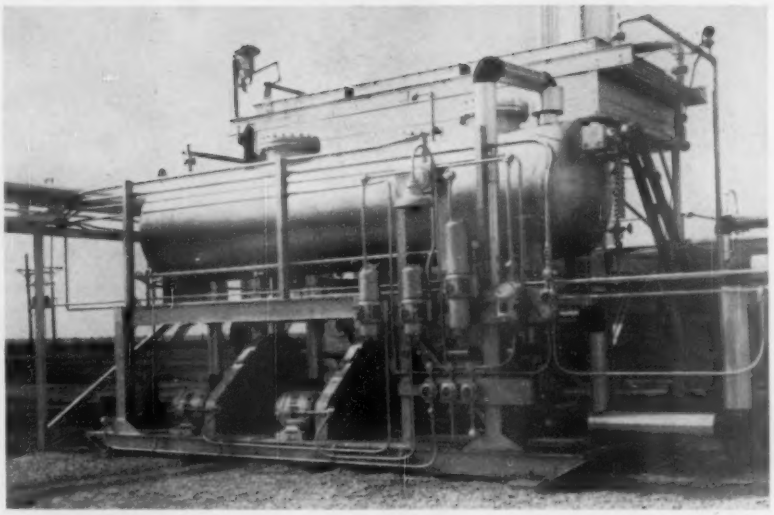
Hydrogen sulfide is removed from

the gas in a 70-ft. by 48-in. o.d. contactor in the plant discharge line. Countercurrent flow of monoethanolamine absorbs the acid gases, H_2S and CO_2, and the rich MEA solution is circulated to the MEA regeneration plant where the acid gases removed from the MEA solution are eliminated by burning at the top of a 50-ft. flare stack. The sweetened gas from the contactor is delivered to the 12-in. discharge pipeline for transmission to the field station at Fritch.

Compressor requirements were satisfied by the installation of five 12-cylinder, 660-hp. packaged units. Each engine is mounted complete with compressors, volume bottles, and one demister on one skid. The cooler with separate coils for gas inter and aftercooling, jacket water, and lube-oil cooling, and the second stage demister are installed separately. Air cooling is by a fluid-driven motor, belted to the fan-gear head and powered by fluid from a hydraulic pump on the prime mover.

For best operating flexibility, both stages of compression are handled by each unit. With the exception of starting air, they are completely self-sufficient. Further, leaving the unit on skids makes future relocation easy should load conditions change.

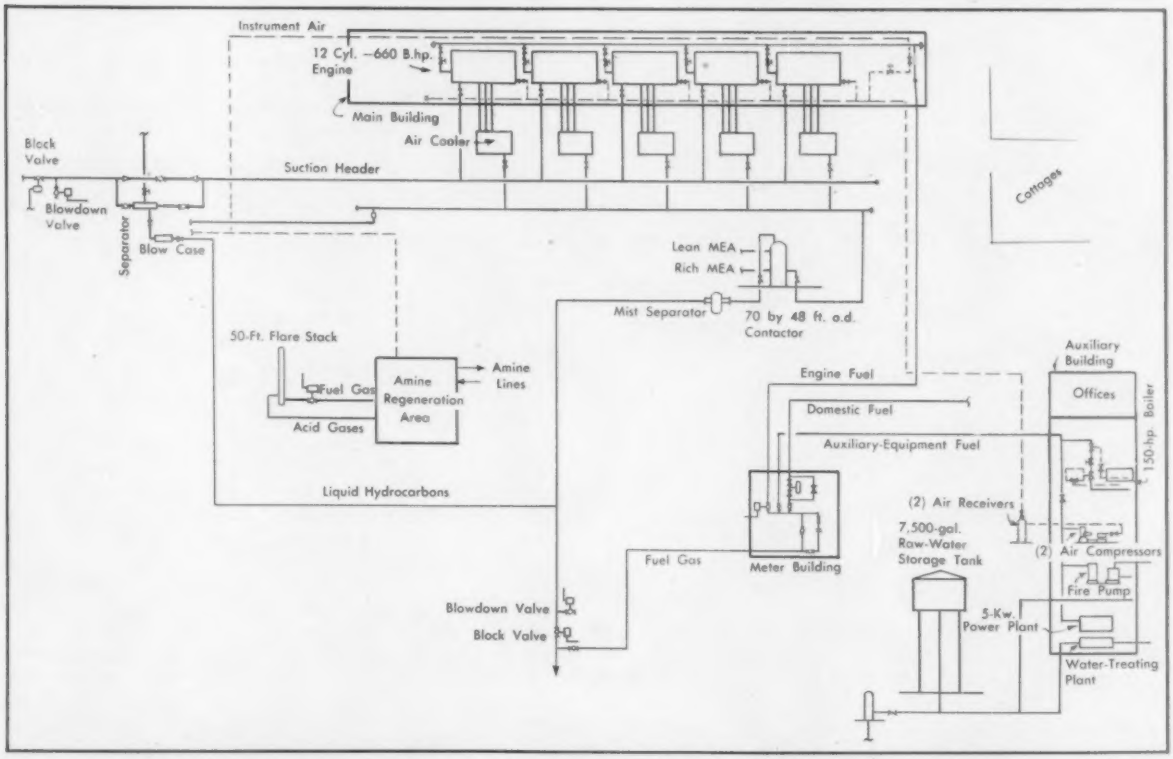
Each engine has four compressors, two first-stage and two second-stage. The first-stage compresses from 25 to 100 psig. and the second stage from 100 to about 290 psig. Compressor discharge temperatures vary from 200° to 250°. The gas temperature is reduced at the cooler to 110° or less depending on ambient conditions. Additional control of cooling is obtained with pneumatically operated louvers atop the coils. Demisters are installed after each pass to trap moisture droplets formed in the gas stream during cooling. All



SKID-MOUNTED EQUIPMENT is used predominantly throughout the station. Plant construction was completed in 3½ months.

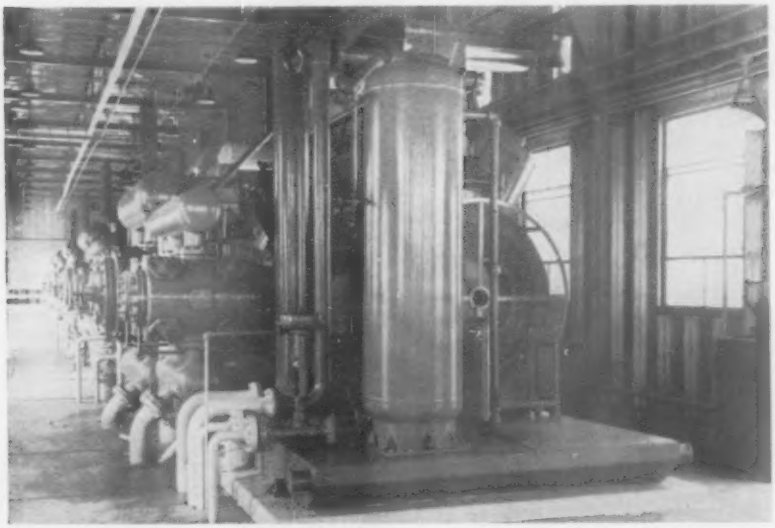
THE AUTHOR

L. V. Parent, engineer special for Natural Gas Pipeline Co. of America, received his degree in chemical engineering at Purdue University. He joined the company in 1950 and has worked as a construction engineer in the field on several projects.



BOOSTER-STATION LAYOUT is compact but uncrowded. The plant is laid out on a 20-acre tract.

AIR COOLERS are used to reduce the gas temperature after it leaves the final compression stage. There is a separate air cooler for each compressor.



FIVE PACKAGED-COMPRESSOR UNITS are used to boost gas pressure from 25 to 290 psig. Each unit is a 12-cylinder, 660-hp. machine.

equipment is situated near the main building to reduce piping. Gas piping is underground wherever possible.

Since compressor-discharge piping would have temperatures in excess of 200°, it was clear that a special coating would be required. Three different types of hot coatings are being tested on the discharge piping, and preliminary reports indicate that all are successful. The engines, housed by a rigid-frame steel-panel building, were set end to end for easy piping installation. An overhead crane aids maintenance operations.

Desulfurization Plant

The hydrogen sulfide content of the gas requires that it be sweetened to be commercially acceptable in interstate sales. A contactor tower, still, and MEA processing equipment comprise the desulfurization plant. A 15 to 20 per cent solution of MEA is circulated through the plant at a 25-g.p.m. rate. Lean MEA from the accumulator is pumped into the top of the contactor and flows downward over bubble-cap trays countercurrent to the gas stream. The rich MEA from the bottom is preheated in a heat exchanger before entering the still.

At the still, 60-psig. steam in the reboiler heats the still bottoms where the MEA-acid gas complex is broken down to form steam and acid gases which are passed from the top of the still to a cooler where the steam is condensed and returned to the accumulator. The acid gases go to the flare stack for disposal. The hot, lean MEA from the still is passed through a heat exchanger and thence to the accumulator tank to complete the cycle.

The effluent gas from the top of the contactor has less than 1 grain of H_2S per 100 cu. ft., an acceptable limit. Process heat in the form of 60-psig. saturated steam is supplied by a 150-hp. packaged boiler unit located in the auxiliary building. Liquid levels and steam flow are regulated by pneumatic controllers. Alarms in the main building warn of loss of amine and steam flow. Continuity of MEA and condensate flow is maintained by electric pumps.

Auxiliary Equipment

Water from a 650-ft. deep 100-g.p.m. water well on the plant site is pumped directly to an elevated storage tank of 7,500-gal. capacity. The 60-ft. head provided by the tower is available for fire fighting in an emergency.

Starting air for the engines is kept in two air receivers near the auxiliary building. Under normal conditions there is enough air at 250 psi. to start two to three engines.

The station-shutdown system is equipped with pneumatic valve operators to close the pipeline block valves which isolate the station. Blowdown valves are also controlled by the same shutdown system which is so designed that the station piping can be blown down in 2 minutes. The flare-stack fuel-gas line is closed off by the shutdown system since the fire there would be a potential hazard during the blowdown. An electrical pressure switch in the auxiliary building is actuated at the same time to cut off all electric power in the main building as well as ground out the engine ignition.

The auxiliary building houses the package boiler unit, electrical control center air compressors, emergency power plant, and water-treating plant.

Fuel gas for the station is taken from the high-pressure discharge line to the meter building where the pressure is cut and the flow measured before delivery as engine fuel, auxiliary equipment, and domestic fuel.

Heating for the plant structures is provided by surplus steam from the packaged boiler unit. All steam condensate and conduit lines are carried on overhead pipe supports. The regeneration plant still, reboiler, heat exchanger, and various gage glasses and small pipes are also insulated, and in some cases, steam traced. To provide additional protection against heat loss in winter weather, a 10-ft.-high windbreak will be installed around the regeneration plant. The acid-gas line to the flare stack has been insulated to prevent cold weather freezeup. **End.**

El Paso lays a pipeline from "A" to "B" without

▲ El Paso spreads cross the San Juan river in northern New Mexico. Pipe was first laid to the edge of the main channel. Then an earthen dam was built upstream. Water flow shifted over the section of line near the far bank and the 800-foot crossing was completed. Trench depth averaged 20 feet, pipe was anchored every 40 feet with tie-down clamps bolted 9 feet deep in the shale.

◀ Laying the 34-inch pipe across the red desert of the Navajo Indian Reservation of Northern New Mexico.

From San Juan, New Mexico, the line travels across the red desert of the Navajo Indian Reservation of Northern New Mexico and through the Foothills of the San Francisco Mountains in northern Arizona near Flagstaff. Near Holbrook, Arizona, it extends under the little Colorado River (approx. 500-ft. crossing). At its terminus, the line stretches 1,100 feet across the Colorado River on a pipeline suspension bridge being built jointly by El Paso and Pacific Gas and Electric Company. ▶

crossing the river!

THEY PUSHED THE RIVER ASIDE! El Paso Natural Gas Company laid their line to the edge of the main channel first, then temporarily diverted the river and used dry land methods to lay the pipe through the main channel. El Paso spreads report the crossing went without a hitch, and was less expensive than going under or over the river by usual methods.

Completed line to increase capacity by 450,000,000 cubic feet per day

Taking approximately 350,000,000 cubic feet daily from the San Juan Basin and another 100,000,000 cubic feet from the Permian Basin, the San Juan-Topock project, as it's called, will increase the company's total deliveries to over two and one-third billion cubic feet daily. Begun in early 1956 and scheduled for completion in early 1957 the new line will supply an additional 350 million cubic feet daily to customers in California and an additional 100 million cubic feet daily to customers in Arizona, New Mexico, Texas and Nevada. The 34-inch line, for the most part, will loop two existing lines (24 and 30-inch) which extend from the San Juan Basin to Topock on the California border.

A. O. Smith supplying 34-inch pipe for two-thirds of 338-mile project

Approximately 224 miles of 34-inch pipe was shipped to El Paso spreads from A. O. Smith Corporation of Texas' plant at Houston. For almost 30 years A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

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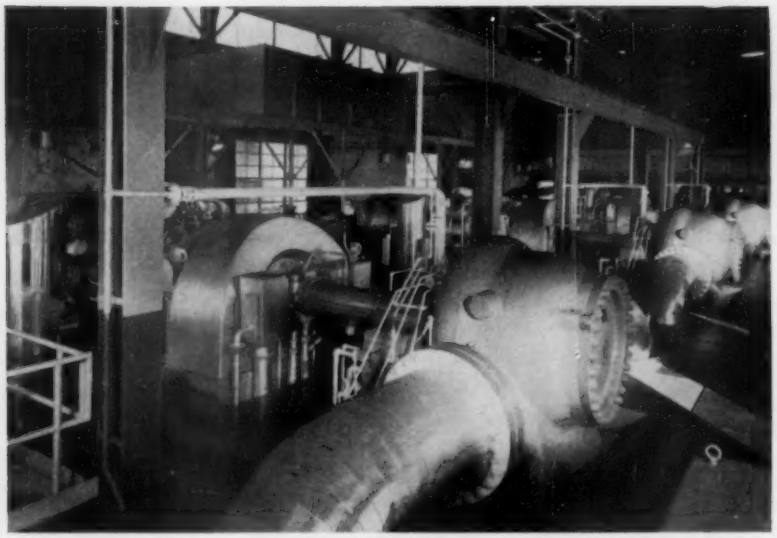
ROUTE of El Paso Natural's southern division main line from Permian basin to California, showing location of gas turbine - centrifugal compressor stations between reciprocating compressor stations. Photo shows gas - turbine - driven centrifugal compressors at Hueco station.

What El Paso Natural Learned



About Centrifugal Compressors

. . . for natural-gas pipelines

Here is a timely evaluation of centrifugals for natural-gas transmission—at the moment when centrifugals are coming into their own for gas pipelines. Recognition of the significance of centrifugals has increased greatly the past year.

by E. A. Walsh and A. H. Carameros

SINCE centrifugal compressors are now being more widely considered for gas transmission, it seems timely to comment on certain advantages and disadvantages of this equipment. Centrifugal compressors are getting increasing attention because of their possibilities for remote control stations as well as for intermediate stations contemplated in the current period of pipe shortage. This discussion draws from El Paso Natural Gas Co.'s experience in 600,000 hours' operation of centrifugal compressors.

The first major application of centrifugal natural-gas compressors was made with electric drive by Texas Eastern Transmission Corp. on its Big Inch line in 1947. Operation of these units has been successful *(The Oil and Gas Journal, page 60, January 22, 1948).*

About 5 years ago, El Paso Natural installed 28 centrifugal natural-gas compressors driven by gas turbines to increase the capacity of its system. Here, for the first time, the user had his choice of the type of compression to do the job. Pipe was not available at that time. Therefore it was necessary to select a type of compressor unit suitable for low-ratio compression at intermediate stations. Now again, 5 years later, the industry is faced with the same situation in the present pipe shortage.

Application in 1952

El Paso Natural Gas Co.'s facilities at that time consisted of a 26-in. pipeline looped by a 30-in. pipe from the Pecos River to the California border. Six reciprocating stations were located about 90 miles apart and were pumping about 800 M.M.s.c.f.d. The company decided to increase the system capacity some 300 M.M.s.c.f.d. by adding intermediate compression between the existing reciprocating stations. This expansion required some increase in horsepower at existing facilities as well as changing compressors on the previously installed horsepower. The problem then was to choose the type of compressor to be installed at the intermediate stations.

Why Centrifugal Was Selected

Both reciprocating and centrifugal compression were considered, and centrifugal was selected because:

1. Higher compression efficiency was

available at the ratio required at the intermediate stations.

2. Piping was considerably simplified.

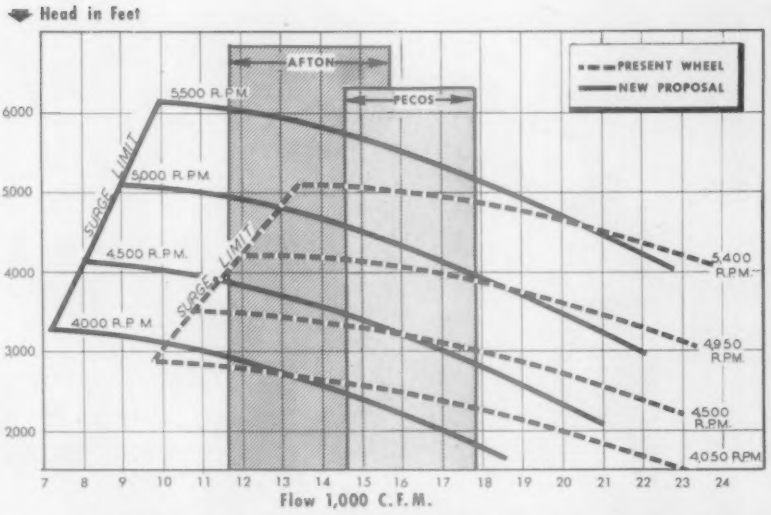
3. The advent of the gas turbine made available a prime mover which had advantages from the standpoint of variable-speed requirements at nearly constant horsepower output.

4. The centrifugal compressor lent itself more readily to possible automation, which was being considered at the time of design.

It is important to review some of these reasons in detail, to bring them up to date.

At the time of our application, the centrifugal manufacturers had developed compressors which were guaranteed to be about 85 per cent efficient at the design point. This design point called for a head of about 5,000 ft. and a flow of 16,000 cu. ft. per minute with a suction pressure of 600 psia. This design feature fitted our needs almost exactly, and exceeded the efficiency being offered by reciprocating compressors manufactured at the same ratios. This advantage is no longer valid since the reciprocating manufacturers have developed compressors which equal, or exceed, the above-mentioned efficiencies.

The piping was for high-flow series operation and it reduced considerably the number of valves and length of pipe required. The economics of this study showed possible equal or higher price for the heavier and bigger pipes and valves, but the smaller number of units required made automatic operation more feasible.



TYPICAL centrifugal-compressor characteristics showing difference in available head and surge limits. Also shown in graph is the operating range of the two gas-turbine centrifugal stations. The Pecos station is 100 miles upstream from the Afton station.

Gas-turbine advantages . . . The availability of the gas turbine at that time seriously affected our decision to use centrifugal compressors. Here we had a machine with variable speed at nearly constant or variable load which matched the requirements of the centrifugal very nicely. Also, the prime requirement for very little water made it more desirable for our desert operation.

Savings in reducing the amount of manpower were being studied. The idea of operating an entire 15,000-hp. plant by one operator per shift had been accepted. This meant that the compressor needed a minimum of attention and maintenance. Our previous experience with reciprocating compressors showed that valve replacement was a necessary and constant problem we would have to accept. Also, proper loading of reciprocating engines had to be done with unloaders. With the use of the

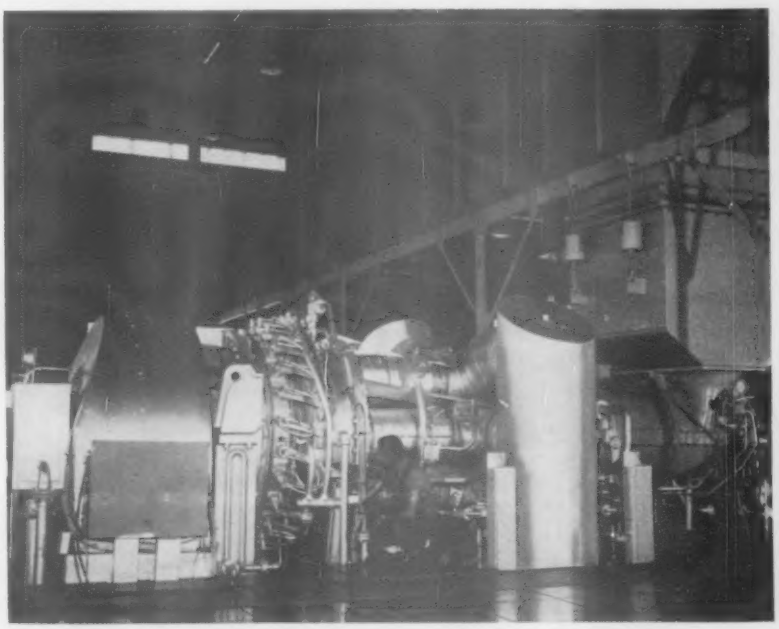
THE AUTHORS

WALSH

CARAMEROS

E. A. Walsh, division engineer, El Paso Natural Gas Co.'s southern division, attended New Mexico A. and M. College, graduating with a B.S. degree in mechanical engineering in 1949. He joined El Paso Natural the same year as junior engineer. Walsh has been in charge of operational engineering for the company's gas turbine-centrifugal compressor stations since they were installed in 1952.

A. H. Carameros, senior engineer, southern division, El Paso Natural Gas Co., received a B.S. degree in physics from Texas Western College at El Paso in 1947. In 1949, he received a B.S. degree in electrical engineering from New Mexico A. and M. College. On graduation he joined General Electric Co. as engineer in the research and development department at Schenectady, N. Y., where he worked for 3 years until he went with El Paso Natural in 1952. He has been closely concerned with analysis of gas-turbine and centrifugal-compressor problems.



ONE OF THE GAS TURBINES driving a centrifugal compressor at the Hueco station.

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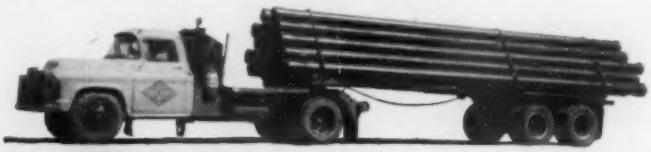

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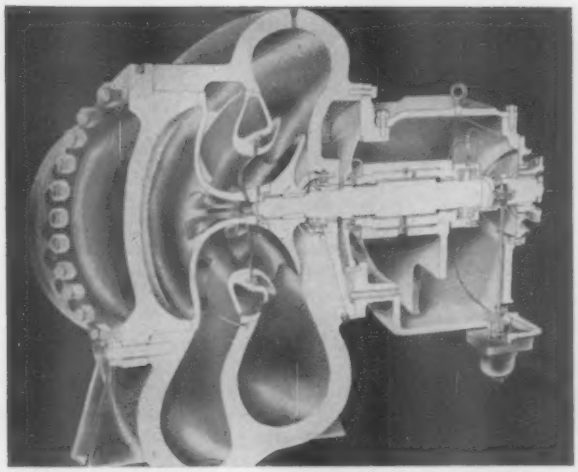
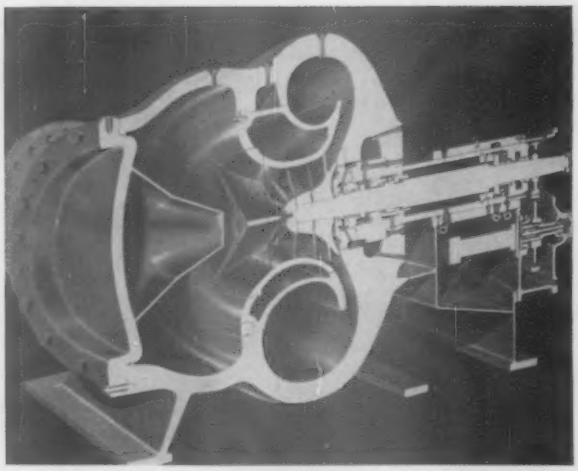
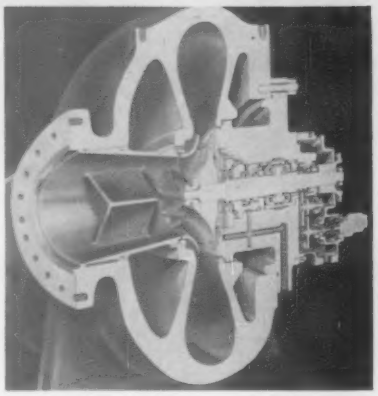






HERE ARE THREE typical centrifugal compressors operating at various stations of the El Paso Natural system.

centrifugal compressors, these routine duties would be eliminated. Basically, no control other than variable speed was needed to operate the centrifugal properly, and this could be done easily by one man.

Of the advantages mentioned above, only one may not be valid today, that one concerning compressor efficiency.

There were certain disadvantages in the use of centrifugal compressors that were probably considered too lightly at the time of application, which we learned to respect more as our operating experience increased. These were:

- Surge.
- High-speed operation.
- Lack of experience in operating centrifugal compressors over widely changing gas loads.

These disadvantages and their effect on our operation will be discussed in more detail later.

Operating Experience

Although there were many centrifugal compressors in use at the time, we had trouble from the standpoint of basic design. This fact came to us as a rude shock, since most of our apprehensions were about the gas turbine rather than the centrifugal compressors.

Early in our installation, we found that one particular brand of compressor would not run very smoothly. In fact, at about 5,000 r.p.m. the shaft vibrated as much as 15 mils peak to peak. This was a limiting factor since to get maximum flexibility out of the compressor we needed to operate up to 5,500 r.p.m. When the machine ran at this speed, the outboard bearing would constantly fail. The problem was thoroughly studied by the manufacturer and the user. After many field tests and calculations, it was learned that the shaft was not stiff enough to prevent shaft whip. The problem was licked by increasing the diameter of the shaft and increasing the bearing span.

Under some hydrostatic tests, this same machine casing cracked. This failure required redesign of a new case. Although this particular brand of compressor gave us the most trouble to begin with, everyone's efforts toward making it right have been rewarded by trouble-free operation since the change-out was effected.

Another brand centrifugal ran for about a year and then trouble began to show up in it. The bearing drain temperature was exceptionally high (185° to 190° F.) and the seals began to fail. The trouble again required redesign of the shaft and bearings to prevent seal failure. Since this modification was made, there have been no seal failures and the oil drain temperature has been reduced to a reasonable range (150° to 160° F.). However, seal-oil consumption is still one thing that can be improved. This will be discussed in more detail later.

A third brand of compressor appeared to be well designed from the standpoint of casing and rotating assembly. Some trouble was experienced in the high-pressure bearing but it didn't appear to be general. This bearing was modified and seems to give good service. Biggest trouble with this particular machine was its violent surge characteristics, which will be discussed later.

Operating Problems

One of the first and most immediate problems was that of familiarizing operating, maintenance, and dispatching personnel with this new equipment. This personnel had previously worked with reciprocating compressors.

The nature of this new machine required a complete change of thought on the part of the operating people. They were now required to pump gas with centrifugal compressors instead of the positive displacement pump which is ordinarily referred to as the reciprocating compressor. The program was carried out by on-the-job training as well as classroom work, given by the various operating and engineering people. The concept of dispatching gas had to be radically changed since the new equipment did not lend itself to "packing the line." This is a very useful method of moving from minimum to maximum gas-delivery requirements.

This problem is too extensive to cover in this article, but is ably covered in a paper presented by H. B. Lafferty, chief dispatcher at El Paso Natural Gas Co., entitled "Gas Dispatching Problems Encountered in the Operation of Gas Turbine and Centrifugal Compressors." The paper was presented at the American Gas Association Transmission and Storage Conference, Pittsburgh, May 1955.

The newest term that operating personnel had to become acquainted with was "surge" or "pumping limit." This term is defined as follows:

There is a minmium capacity for each blower (centrifugal compressor), at every

speed, below which the blower operation becomes unstable. This instability is accompanied by a characteristic noise known as "pumping" or "surging." The pumping limit is determined largely by the impeller discharge angle, and for the average blower it lies in the neighborhood of 50 per cent of the capacity at the best efficiency point. The primary cause of this behavior lies in the shape of the head-capacity curve which, after reaching a maximum at about half of rated capacity, begins to "droop" toward the zero-capacity point. When the capacity is reduced below this point, the pressure in the discharge pipe exceeds that produced by the blower and the flow tends to reverse momentarily. However, as soon as the flow is further reduced, the pressure drops in the discharge pipe and the blower begins to discharge into the pipe again. Such pulsations in pressure and capacity are magnified by the response of the compressible gas in the discharge system.

Turboblowers, by A. J. Stepanoff, Ph.D., John Wiley & Sons, Inc., New York.

The severity of surge seems to vary depending on the brand of centrifugal compressor. This severity may vary from a howling noise during surge to a severe pounding which has enough energy to shake the compressor casing and associated piping.

Maintenance Advantages

From a maintenance standpoint, the centrifugal compressor is extremely simple. Most single-stage compressors consist primarily of a case, two journal bearings, and one thrust bearing, a shaft, high-pressure seal, and an overhung impeller. Such simplicity gives promise of low upkeep. This has proved true. The compressors have no definite overhaul schedule and are not touched unless vibration or oil consumption becomes excessive.

Most of the vibration, since our original troubles were corrected, stems from unbalance. In fact, this is the key to smooth trouble-free vibration.

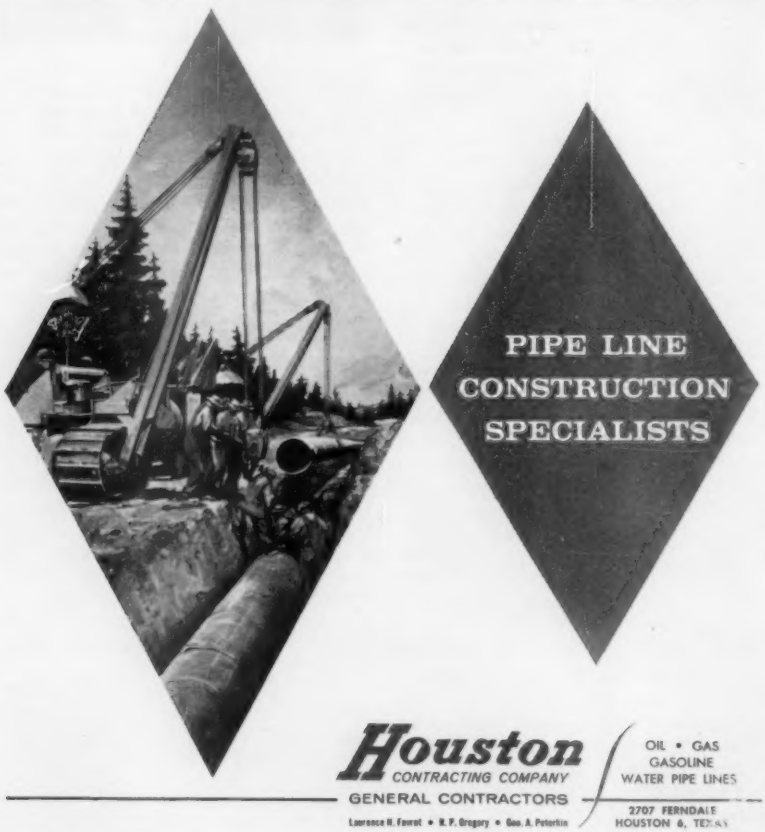
Good dynamic balance becomes extremely important in these machines since speeds ranging from 4,000 to 6,000 r.p.m. are not uncommon. A typical example which can be used to emphasize this point is this: Suppose we have a shaft and impeller assembly which weighs 800 lb. The machine is expected to run smoothly at 6,000 r.p.m. In order that the machine run smoothly, the unbalance force at 6,000 r.p.m. must be some fraction of the weight of the impeller. (For example, use one-fourth.) This means that the maximum of allowable unbalance force is 200 lb. An unbalance of 1 oz. at a distance of 4 in. from the center of the shaft turning 6,000 r.p.m. would give a force of about 264 lb. Actually, most of our centrifugal equipment is balanced during overhaul to within 10 to 40 in.-g. depending on the weight of the motor.

Low lube-oil use . . . When the gas turbine and the centrifugal compressor were decided upon as the combination which was to pump gas for our increased demands, one of the inherent advantages of this combination was low lube-oil consumption. The lube oil for the gas turbine and centrifugal compressor is supplied from a common lube-oil sump. This makes it rather difficult to separate the oil lost in each component. However, if we compare the over-all oil consumption for each unit, there are some differences in oil consumption and we choose to blame the differences on the oil leakage in the high-pressure gas seal in the compressor. Our assumptions have been proven correct since any time we have high-oil consumption, the compressor seal is changed out and consumption drops.

The question might be asked, "What is a good figure for oil consumption?" We would like to establish a figure of 5 to 10 qt. per 100 hours of operation as such a figure, and we do have some units that perform that well. However, some of our units use as much as 100 qt. per 100 hours of operation. The reasoning used in coming by these figures is not solely from the cost of oil used since our worst consumption might only cost $110 per month, but from the effect the oil has when it gets into the pipeline. This oil in the pipeline reduces the pipeline efficiency, which could amount to a large expenditure in horsepower or "pigging" to compensate for the lost efficiency.

Seal-oil system . . . It should be mentioned that high-oil consumption is not due solely to the seal design, but the seal and the seal-oil system are so closely integrated that unless both are properly designed, installed, and maintained, the oil consumption cannot be kept to a minimum. The seal and the seal-oil system should be designed to prevent oil leakage into the case when the unit is not running as well as while it is running, since when the centrifugal compressor is applied with a gas-turbine, a 3-hour cool-down period is required with oil pumps running with all rotating power shafts at a standstill.

Since our pipeline system is required to pump gas over widely varying flows, the surge limit of each machine became an important factor in our operation. Careful inspection of these curves showed that one design for the Pecos River appeared to be adequate, while the same design at Afton station was not. This type of operation required a redesign of the impeller for Afton station to lower its surge limits. This redesign brought on other complications which are still being studied. **End.**



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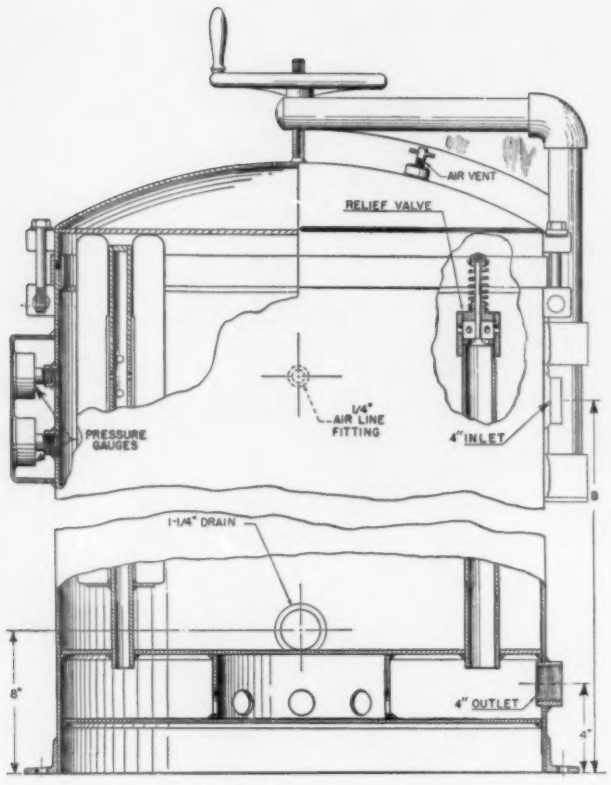

Work with units of this type shows that . . .

Water Filters Aid in Pressure-Testing a Pipeline

Transco employed filters to clean up water prior to use in hydrostatic testing of lines. Removal of sediment permitted line to be cleaned merely by use of squeegees.

by Larry Resen
District Editor

WATER filters were used by Transcontinental Gas Pipe Line Corp. in its hydrostatic-testing program during recent pipeline construction.

Lube-oil-type filters were used to clean up stream water before it was pumped into pipeline sections for pressure testing. After tests were completed, it was nearly always possible to clean the line simply through use of squeegee pigs. There was no need for wire-brush scrapers to be run through the line. Water entering the pipeline through filtration units was clear and there was no settling of sediment in a 24-hour period.

Transco used the filters on more than 600 miles of 30-36-in. main-line pipe and 24-in. laterals during its 1955-1956 expansions.

Filter units . . . The filter units, constructed by Perry Equipment Co., Mineral Wells, Tex., each consisted of two filter cases mounted on skids and connected in parallel. Each of the filter cases was equipped with 60 disposable filter elements. Water enters through a port opening high on each case, passes through the elements, and leaves through the base of the case. A dished head on each filter is secured by hold-down bolts. This head cover is removed when replacing the filter elements. It is equipped with a swing bolt and lifting arm so it can be conveniently moved out of the way when servicing the case. Each filter could be returned to lube-oil service as a full-flow oil filter following its use in the testing program. This required a simple renovation at the factory.

In using the filters, the original setup was to have one skid-mounted unit, with a total of 120 filter elements per testing spread. The unit had a maximum-flow capacity of 2,100 g.p.m. of low-turbidity water, or approximately a 1,200-g.p.m. capacity of high-turbidity water. The maximum testing pump capacity used by contractors the previous season was 1,400 g.p.m., hence the unit capacity was felt to be sufficient.

However, after testing commenced in 1955, it developed that some of the contractors had increased their pumping capacity to as much as 2,400 g.p.m. When high-turbidity water was being handled—as a result of rains or natural stream conditions—the filters plugged up quite rapidly. This reduced their effectiveness as well as the pumping capacity. Two corrective steps were taken.

Prevention of plugging . . . The filters originally used were equipped with lube-oil filter elements with the excelsior packing being fairly compact. A loosely packed filter was substituted and proved far superior for this service. It didn't cake up as rapidly as the tight pack and hence afforded a greater capacity with longer life. In addition, two filter units were manifolded together to be used whenever high-capacity pumps were in service. This doubled the filter capacity as it provided four filter cases connected in parallel with a total of 240 filter elements in service.

Element protection . . . The filter cases were normally installed between a low-head centrifugal pump and a high-head reciprocating pump. The former is used as a booster to pick up water from the spread source, pass it through the filters and then provide it at a pressure to the suction of the high-pressure test pump. In some instances testing contractors not equipped with low-head pumps tried to use the units on the discharge of high-head pumps with pressures as high as 200 psig. The filters were designed for a maximum working pressure of 125 psig. This in itself did not provide a problem since the inherent safety factor in the filter cases made it possible for them to withstand the pressure. However, some operators did not

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"Generally speaking, use of the filters in hydrostatic testing in nearly all cases will cost less on an over-all basis than cleaning sedimentation from the line with pigs."

equalize the pressures in the cases and the sudden impact of full-pump discharge pressure either compacted the elements, restricting the flow, or collapsed the element's center tube, closing its seal. Whenever the high-pressure reciprocating pump was started, the reciprocating action also proved harmful to the elements.

A clean filter unit has about a 2-lb. drop across each case. The normal run extended until a pressure differential across the case reached 50-60 lb. New elements were then inserted. While the hydrostatic test continued, the elements could be physically inspected at any time by taking the filtration units out of service individually. If caking or serious distortion had taken place, they were changed.

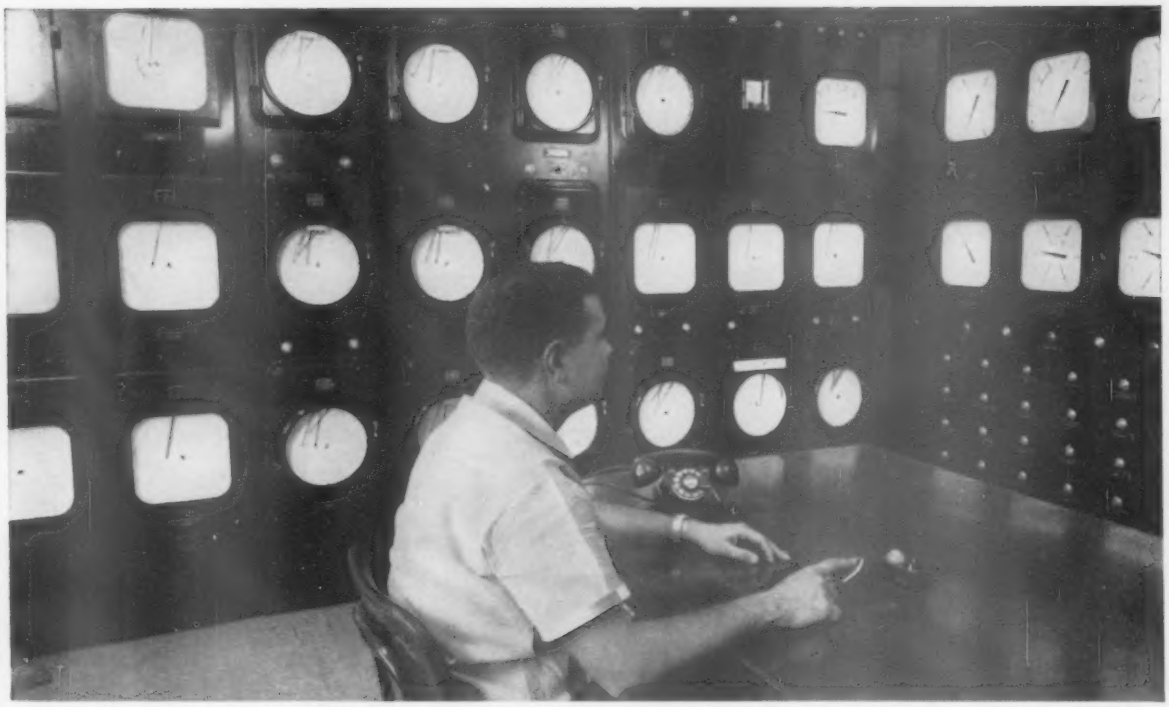
Element life . . . The length of each run varied considerably. Individual stream conditions varied and water was obtained with both low and high turbidities. The weather changed and rainfall contributed to high stream turbidity. In some cases it was possible to get 15-20 miles of pipeline tested on a single set of elements. In other instances, a much shorter operating run was experienced and elements were changed frequently.

An example of an average run was at the Tom Bigbee River near Butler, Ala. A single unit was operated for 9½ hours pumping from the river immediately following a rainy spell. The river was 3 ft. above normal level and had a high turbidity. During this run, 570,000 gal. of water was pumped without a filter change. This water filled 16,600 ft. of 30-in. pipe. The run was accidentally halted at 9½ hours when a valve was unintentionally closed and the resultant 300-lb. pressure in the cases compacted the elements.

Generally speaking, use of the filters in hydrostatic testing in nearly all cases will cost less on an over-all basis than cleaning sedimentation from the line with pigs.

Acknowledgments

The cooperation and assistance of Gene Proper, Transcontinental Gas Pipe Line Corp., and Brock Mott, Mott Co., Houston, suppliers of the filters, are hereby gratefully acknowledged.



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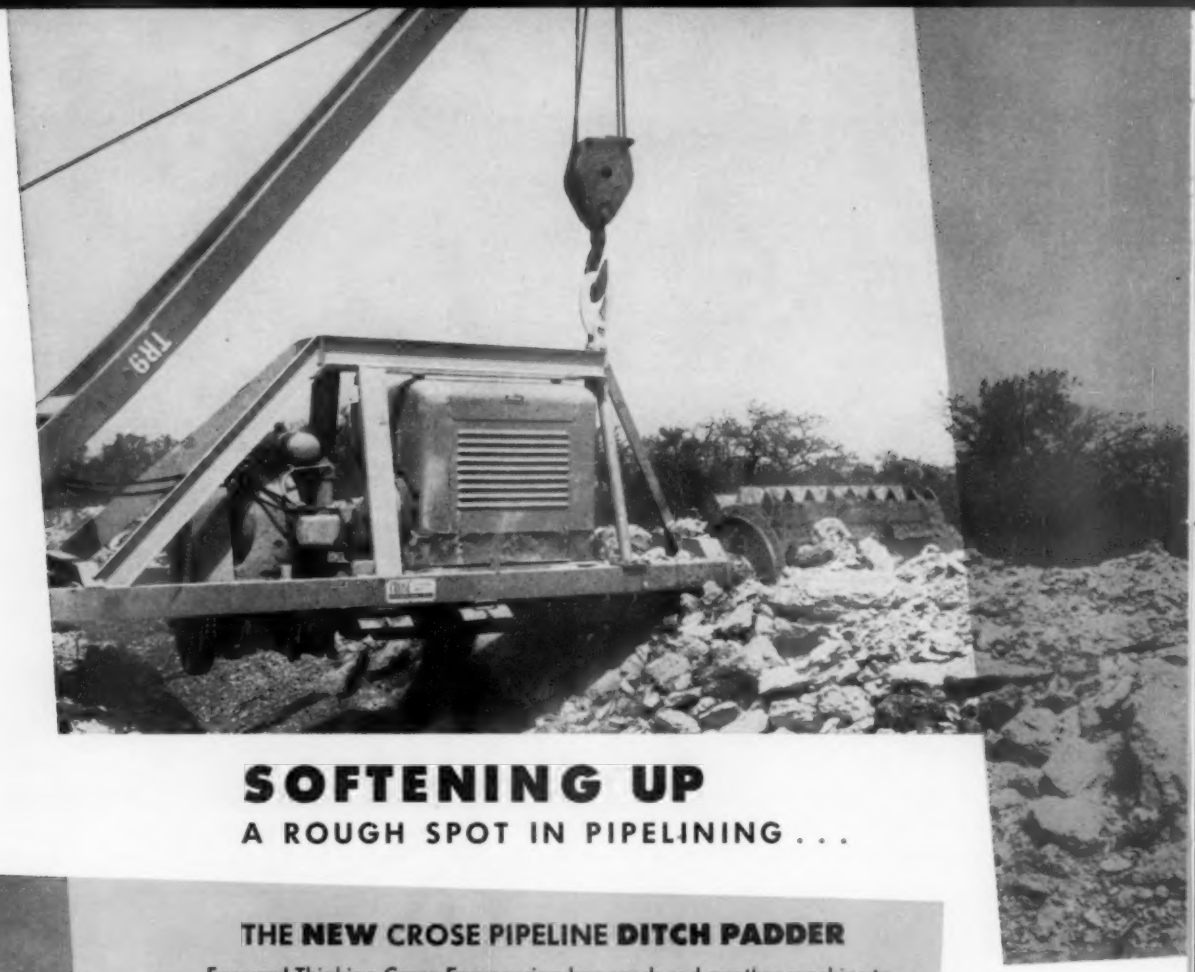

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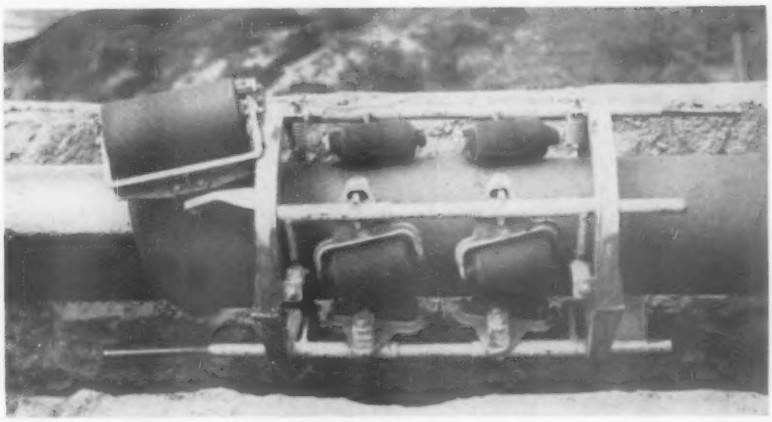
Pipelines were hand-wrapped until 1931 . . .



. . . when C.R.C.'s Gene Rolf developed this machine. Now

Coal-Tar Enamels Still Rate High With Pipeliners

by Stephen D. Day

COAL-TAR enamels have been used successfully to protect pipelines for 30 years. During this time it's been found that they meet these requirements:

1. Continuity.
2. Adhesion to pipe surface.
3. Resistance to deformation under pressure.
4. Resistance to moisture absorption.
5. Resistance to cracking or softening under anticipated temperatures.
6. Low electrical conductivity.
7. Chemically inert under all subsoil conditions.
8. Ease of application.

Author is with S. D. Day Co., Houston.

Enamel is so quick-setting that contractors are never held up while waiting for the enamel to dry. It is made up of coke-oven coal-tar pitch to which is added a finely ground filler to stabilize the pitch and reduce cold flow. It is a semisolid and can only be applied at temperatures above 385°. Being molten material, it sets on cooling. There are no volatiles in it, so no curing time is necessary.

Natural Gas—Gas Pipelines

A prime example of pipeline construction is in an oil line which was laid in 1948 from Jal, N. M., to Cushing, Okla. The pipe is 22 and 24 in. in diameter and is protected by this specification:

Coal-tar primer.
Coal-tar enamel.
Fiber glass.
Coal-tar enamel.
Fifteen-pound asbestos felt.

Complete cathodic protection was then applied to the system. During 9 years of service there has been no loss of insulation value of the protection. The line stands as an example of how to build a pipeline for keeps.

Many improvements have been developed in application methods. One-pass equipment now travels along the top of the welded pipe. Glass fiber strengthens coating and reduces cold flow.

By using the stationary coating-machine method, every phase of the cleaning, priming, coating, and testing operation is closely controlled. In the northern plants this work goes right through the winter months since the plants are heated and the drying sheds are controlled to keep the drying time uniform. The field joints can be given a continuous coat of enamel by using field jointers which are really expendable forms that hold the hot coating in place until chilled and then serve to eliminate cold flow.

With pipe protection established it is now safe to design thin-walled steel pipe. This has lowered costs and made feasible a whole new mode of long-distance transportation. Large oil and gas systems now use relatively thin walls of steel in large-diameter pipe with perfect safety. At the same time an equally important dividend has developed. Financial interests recognize that money can be safely loaned on long-range pipelines protected by enamel and asbestos felt, both protected by cathodic protection.

By using coal-tar enamel as the first step toward immunity, then following with electrical protection as the final step, underground steel pipe is safe against corrosion.

The first hot-applied coating, still on the market, was one to which has been applied the term "narrow-range enamel." It is produced from a homogeneous mixture of selected coal-tar pitch and a selected mineral filler to give the best possible service underground and ease of handling in application.

This coating was the only hot-applied coating on the market until the development of "coal digestion products."

These coatings are made from coal-tar pitch, coal-tar heavy oils, and bituminous coal, all carefully selected and processed to produce a base pitch, which is combined with mineral filler to produce the finished coating.

With the advent of the coal-digestion-pitch coatings, it became possible to vary the characteristics of the coatings over extremely wide ranges as compared to the original narrow-range coating, frequently called "filled pitch coating."

The narrow-range coating is termed narrow range because of the limited temperature range through which the coating may be used. Straight coal-tar pitch (the residue from the partial distillation of coal tar) has excessive cold-flow characteristics. In other words, a piece of the pitch, which may be sufficiently hard or high in softening point, to shatter quite easily when struck with a hammer, will flow and flatten out at normal temperatures when left undisturbed.

The prevailing specification for the narrow-range enamels today calls for a softening-point range of 190°-200° F. This coating, applied to metal surfaces and subjected to temperatures below 30° F., will crack and disbond from the metal because of cold temperature. This same coating on vertical surfaces exposed to temperatures above 110° F. will tend to flow and sag the metal surface. Thus, its safe useful temperature range is quite narrow, being only approximately 80°.

Increasing the softening point of the base pitch increases the high-temperature resistance, but at the same time decreases its resistance to low temperature. The reverse of this is true when the softening point is lowered. Therefore, raising or lowering the softening point of either the coating or the base pitch will improve some characteristics but, at the same time, lower quality elsewhere.

The development of the coal-digestion pitches made possible great changes in the high and low-resistance temperature and other characteristics of the coatings with out losing any of the corrosion resistance of the original narrow-range enamel. Coal-digestion pitches may be made as hard to the touch as straight coal-tar pitches, yet the safe, useful temperature range of such pitches may be double that of the straight pitch.

The coal-digestion pitches may be made so soft that they will feel like a soft wax, yet their flow characteristic may be such that they would not flow from a vertical surface at temperature as high as 225° F. Thus, the coal digestion makes it possible to produce coatings that meet special requirements which may be very wide in nature.

To a certain extent this has been done in the production of the four major coal-digestion products available from the stock of the suppliers today. In general terms these four coatings are the moderate-range enamel, wide-range enamel, American Water Works specification enamel, and hot pipeline enamel.

In recent years, we have learned that it is more important to select the coating for conditions in service underground than conditions during application. All of this leads to one definite conclusion: that in the use of a protective coating, whether it be coal tar or otherwise, the coating should be selected to fit the conditions and performance required of the coating on the underground structure.

Some specific recommendations with regard to the proper coating for the underground conditions can be made, as given in Table 1.

Coating precautions . . . One point in caution should be made in using this summary of coating uses. All statements are made exclusive of application conditions. In application the most serious stumbling block is low temperature at the time of application. We know that

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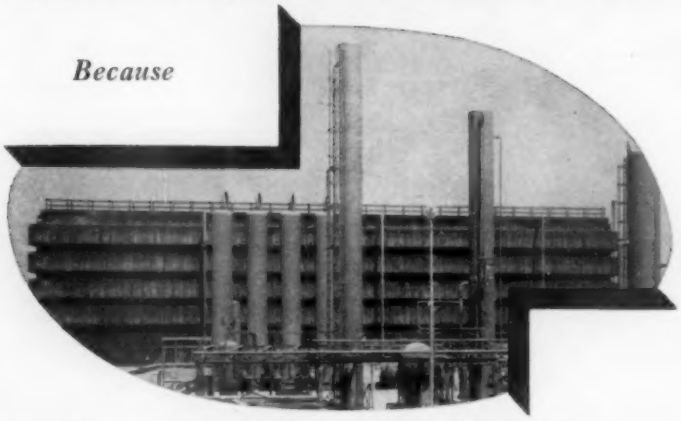

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TABLE 1—RECOMMENDED COATINGS FOR SERVICE UNDERGROUND

Underground conditions in service	Recommended coating
1. Smooth dirt backfill—little or no soil stress—operating temperature not above 110° F., nor lower than 30° F.	Narrow-range enamel
2. Average soil, backfill and soil stress—operating temperature not above 130° F., nor lower than 0° F.	Moderate-range enamel
3. Smooth backfill, no stones, average soil stress—operating temperature not above 150° F., maximum low —20° F.	Wide-range enamel
4. Water works structures, smooth backfill, no soil stress—operating temperature not above 140° F.; for coating and lining	A.W.W.A. enamel
5. Water works structures, average soil and backfill—operating temperature not above 150° F.	Wide-range enamel
6. Rough, stony backfill—high soil stress—operating temperature above 140° F., or all	Hot pipeline enamel

the hot-applied coatings have been applied to metals at atmospheric temperatures as low as 0° F. Common sense says that it should not be done at less than 35° F. for best results.

At lower temperatures moisture must be driven off the metal by preheating the metal, primers dry slowly and are apt to be wet when the coating is applied, and many other dangers exist.

A second point is the handling of the coated structure at low temperature. The cold-cracking temperature indicates the safe low temperature the coated structure can stand undisturbed without the coating cracking and disbonding because of the cold. If the structure is to be handled or flexed at low temperatures, such temperatures are much higher as shown in Table 2.

High-soil stresses . . . If the underground structure is to be subjected to extremely high-soil stresses, as occurs frequently in the southern part of the United States, the hot pipeline coating is ideal for such operations, as well as being ideal for high-temperature lines.

TABLE 2—SAFE HANDLING TEMPERATURES FOR COATED STRUCTURES

Type of coating—	Safe low temperature—Of exposure, undisturbed structure (°F.)	Safe low temperature—For careful handling of structure (°F.)
Narrow range	30	50
Moderate range	0	30
Wide range	—20	20
A.W.W.A.	—20	15
Hot pipeline	0	40

This brings up another point which is quite critical in the selection of coatings and their use. When specifying a coating, be certain that the coating supplied meets the specification desired.

New coal-tar coatings are being developed and it is hoped that improved coatings will be placed in the hands of the engineers as developments progress. These may be combinations such as a combination of a coal-tar phenol-formaldehyde resin or the coal-tar epoxy coatings and others of this nature.

The coating industry is not standing still but is working toward the development of new and better coatings—this, in spite of the excellent record and excellent protective qualities of the present coal-tar coatings.

Reference

Starr Thayer, "Prevention of Pipe Corrosion, Highly Developed Technique," The Oil and Gas Journal, September 25, 1941, page 60.

"**. . . in the use of a protective coating, coal tar or otherwise, the coating should be selected to fit the conditions and performance required of the coating on the underground structure.**"

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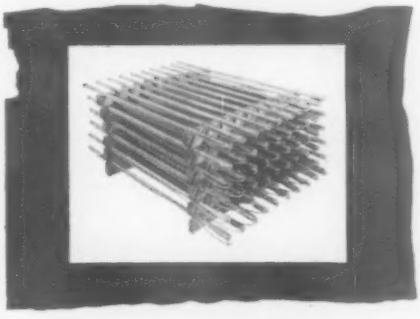

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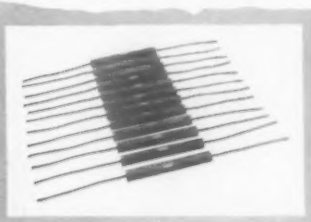

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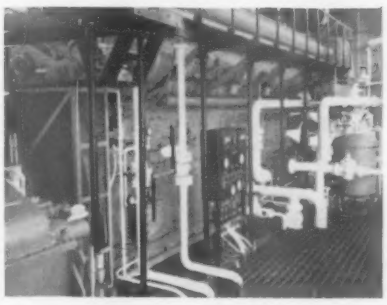
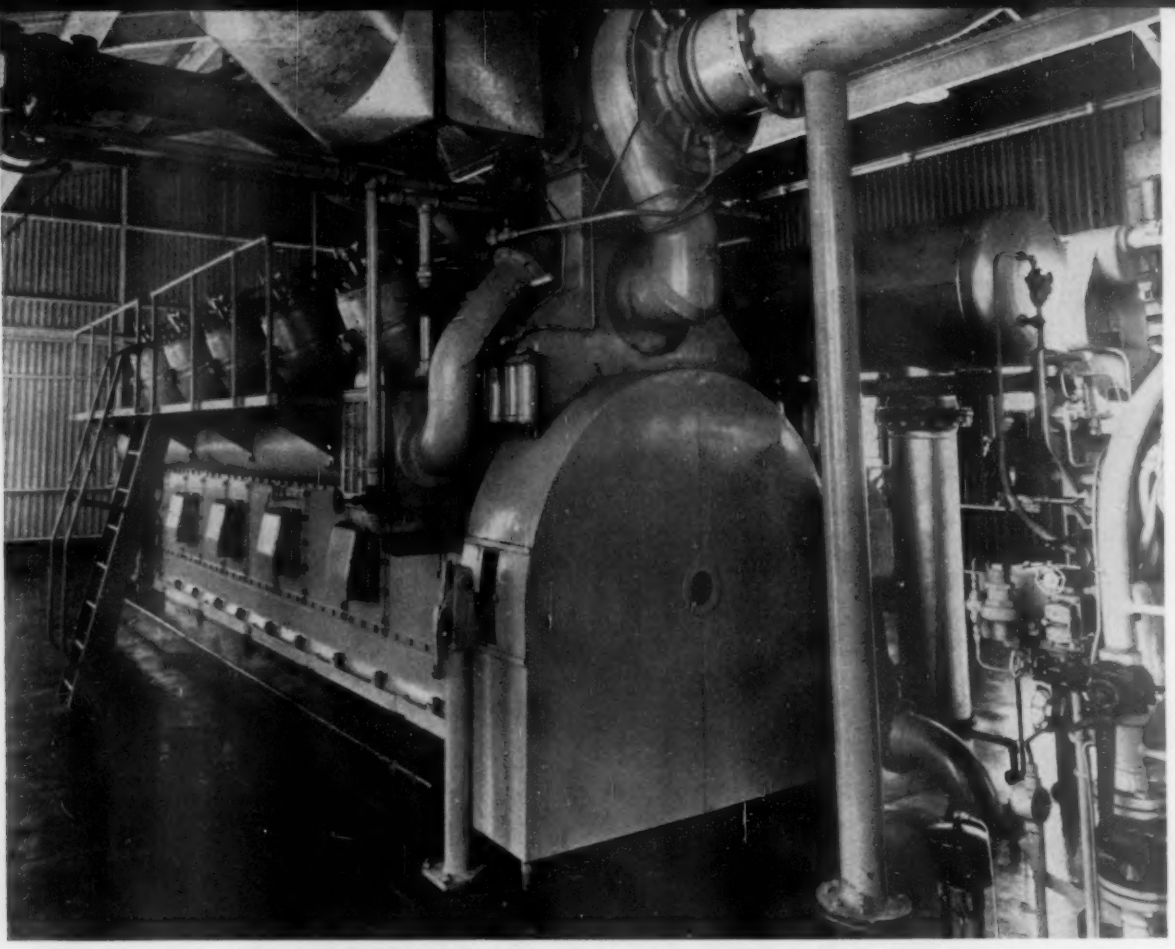


In Gulf Interstate's satellite station near Stanton, Kentucky, this Cooper-Bessemer centrifugal compressor is driven by a 4-cycle Cooper-Bessemer engine operating economically on natural gas from the pipeline.



PEGASUS STATION of Magnolia Petroleum Co. with engine-driven compressor series turbocharged to 1,800 hp.

A story of evolution

SERIES TURBOCHARGING . . .

for two-cycle gas engines

by W. R. Crooks and T. O. Kuivinen

TWO-CYCLE gas engines with series turbocharging have been proved in service. The system is completely self-starting. There are no mechanical disconnect devices. It retains all the starting characteristics of the mechanically scavenged engine. It is one of the most efficient two-cycle turbocharging systems known.

The series turbocharging system, in which one stage of scavenging air compression is accomplished by a mechanically driven centrifugal compressor, and the other stage driven by the turbocharger, is particularly applicable to high elevation.

This means that two-cycle engines can now be operated at elevations up to 7,500 ft. without derating the engine horsepower. Prior to this time, all engines had to be derated in horsepower at altitudes above 1,500 ft.

Development . . . Actual development work in turbocharging two-cycle engines started as far back as 1951, although turbocharging of four-cycle engines dates back to 1934. Out of the original four-cycle-engine turbocharging development has come the spark-ignited turbocharged gas engine typical of which are forty-two 3,700-hp. engines at Reynolds Metals' aluminum reduction plant, in Corpus Christi, Tex.

Several years of hard operating experience under the severest conditions bear out remarkably low operating costs in the generation of electric power with turbocharged units.

On the two-cycle gas engines, however, the first installation of turbocharging was with a type GMV-10 turboflow engine normally rated at 1,100 hp. The first conversion to all-exhaust turbocharging was made early in December 1953 at the Cambridge, Ohio, compressor station of Tennessee Gas Transmission Co. As far as we can tell this was the first turbocharged two-cycle engine operating on a gas pipeline anywhere in the country.

This engine now has well over 22,000 hours of operating service, including three summers. The engine has been

developing from 1,350 to 1,500 hp. representing approximately 92 b.m.e.p. The remaining seven two-cycle gas engines at the station now have had turbochargers added to them, making this a 100 per cent turbocharged compressor station.

Turbocharging systems . . . In the development program, consideration was given to both pulse and constant pressure turbocharging systems. The pulse system as normally used on the four-cycle engine had, of course, sufficient power to pump air for starting the engine and for operating the engine under light load conditions.

Unfortunately, considerable back pressure created at the cylinder at the start of the scavenging period became a limiting factor to the output of the two-cycle engine. Constant pressure turbocharging, on the other hand, had less restriction to the flow of exhaust gas.

However, the characteristics of the constant-pressure system are such that sufficient energy cannot be delivered to the turbine to pump air for starting and operating under light loads. The constant-pressure system does not sustain itself until about five-eights of full load is developed by the engine.

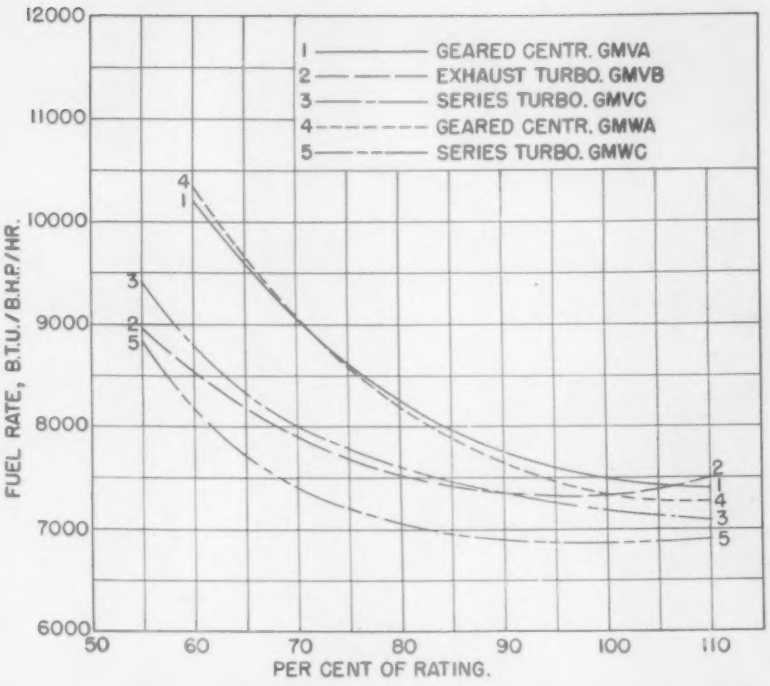
After careful consideration of both turbocharging systems, the constant-pressure system was selected to eliminate the back-pressure problem. Some method then had to be found to start and operate the engine at light loads until the turbocharger would deliver sufficient air to sustain operation.

The first approach to this problem was the use of a combustion chamber to run the turbocharger as a gas turbine. This aided starting and provided sufficient scavenging air to the point where the turbocharger could take over by itself.

Various mechanical aids were also tried such as mechanically driven scavenging blowers for above-load conditions. Because of difficulties encountered with the constant-pressure system with after-burner assist, the original constant-pressure system was abandoned.

Self-starting system . . . All our efforts were then concentrated in developing a self-starting system and one that would be self-sustaining at all loads. A study was made on use of pressure-wave systems for scavenging two-cycle cylinders and providing sufficient exhaust power to furnish all the necessary air needed for a two-stroke engine.

Out of this development work came the first all-exhaust turbocharging for the two-cycle gas engine using the pulse system.



COMPARATIVE FUEL CONSUMPTION of all-exhaust turbocharged and series turbocharged engine-driven compressors with mechanically driven blower scavenged GMVA and GMWA units.

As of June 30, 1956, operating time on the eight turbocharged engines at the Cambridge station totaled 76,846 hours. The average output per engine was 1,400 hp. Lubricating-oil consumption has averaged 8,220 hp.-hours per gallon of oil for the engine only. Fuel consumption has averaged 7,430 B.t.u./b.hp./hr. in spite of variable load conditions.

Efficient unit . . . The all-exhaust turbocharged two-cycle engine is a relatively efficient unit. The increase in efficiency, of course, depends on what existing engine is used as the starting point for comparison. On the field-converted two-cycle turbocharger, fuel economy at full-load rating averages about 7,300 B.t.u/b.hp./hr. or slightly less.

It is always difficult to anticipate unforseen trends, but it is reasonable to believe that the ultimate in the all-exhaust turbocharged two-cycle gas engine may be 7,000 B.t.u.'s, with the engine being self-starting.

There are a large number of two-cycle gas engines in the field today operating on approximately 10,000 B.t.u./b.hp./hr. On these engines it would be possible to save 27 per cent on fuel with all-exhaust turbocharger conversion kits developed for this very purpose.

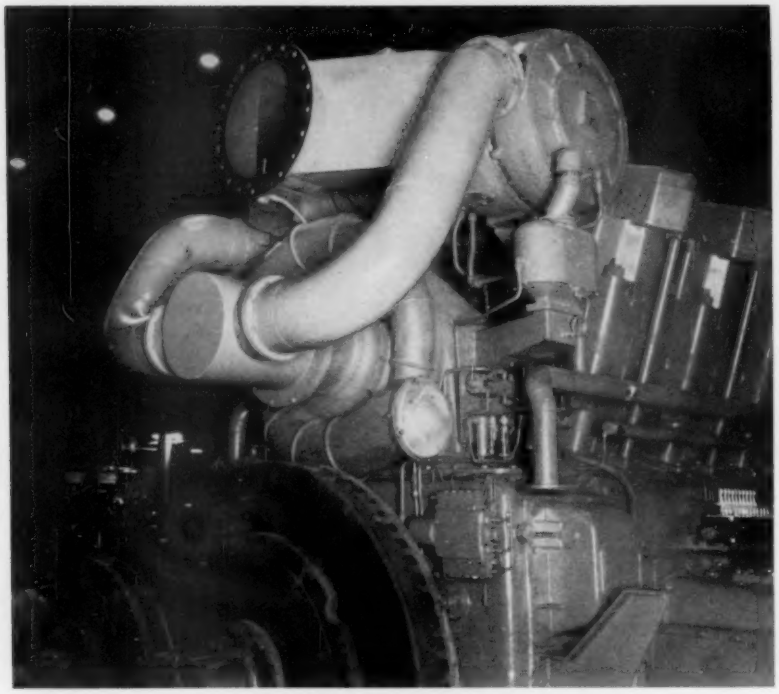
There are also a large number of engines in use today that operate at approximately 8,300 B.t.u.'s. On these, 12 per cent saving in fuel could be expected. On later-type engines, of which there are a considerable number in use, fuel consumption averages 7,500 B.t.u.'s. Obviously, little gain in fuel economy could be realized here.

Further work . . . Further development work on turbocharging indicated that except for starting and light-load operation, the constant-pressure system might provide better load characteristics. The two-cycle engine was therefore equipped with a mechanically driven centrifugal blower. The result was a more efficiently scavenged engine with fuel economies of 7,200 to 7,400 B.t.u.'s depending upon the size of the engine.

THE AUTHORS

W. R. CROOKS T. O. KUIVINEN

W. R. Crooks is chief engineer of the development division of Cooper-Bessemer Corp., Mount Vernon, Ohio. T. O. Kuivinen is chief engineer of the technical division of the company.



SERIES turbocharging unit on engine-driven compressor.

The engines equipped with the mechanically driven centrifugal blowers were identified as the GMVA and the GMWA. Actual fuel economies realized with the mechanically driven centrifugal blower scavenger unit approach the fuel economies of the all-exhaust driven turbocharger. These are shown in the chart.

With the GMVA 10-cylinder engine equipped with mechanically driven centrifugal blower, it became possible to develop 1,350 hp. with a 14 by 14-in. engine formerly rated at 1,100 hp.

Because of the performance achieved with straight turbocharging of the two-cycle gas engine, it was decided that if supplemental air could be furnished by a turbocharger and paralleled to the original reciprocating scavenger pumps it would be possible to increase still further the horsepower of existing engines already in the field. The basic problem, however, was to develop a turbocharger that would deliver the necessary air at a pressure high enough to parallel the positive scavenger pumps.

This meant the coupling of a small-flow, high-pressure ratio blower to a large-flow, low-pressure-ratio turbine. This system lent itself to extremely simple conversion of pump-scavenged engines.

Units of this type have been proven highly successful as evidenced by their performance on the Panhandle Eastern Pipeline. At the company's Guymon, Okla., station, two units normally rated at 1,100 hp. are now pulling 1,350 hp. through parallel turbocharging.

At the Zofness station GMV-6 unit has been similarly boosted from 660 to 800 hp. All three engine-driven compressors, incidentally, have been operating since they were converted to turbocharging in July 1956.

Other units . . . Further experience with parallel turbocharging is demonstrated with engine-driven compressors at the Seward booster station of Panhandle Eastern. Here two GMV-6 units, similarly converted to parallel turbocharging, are daily pumping 15 M,M.c.f. of gas per unit from 220-psi. suction to 625-psi. discharge into a main pipeline. The elevation at Seward station is 2,800 ft. The units have been operating continuously since they were started up in September 1956.

Warren Petroleum Corp. has been operating such a unit since May 1956 at its Panther Creek station. Two GMV-10 engine-driven compressors, turbocharged to 1,350 hp., have been going continuously at Cities Service Gas Co., Edmond, Okla.

According to present plans, 56 similar conversions to parallel turbocharging are being considered by compressor operators throughout the country.

Development work with the four-cycle engine indicated that substantial increases in engine horsepower were practical from the 115 to 130-b.m.e.p. ratings and up to 200-b.m.e.p. ratings through high-pressure turbocharging and after-cooling. It appeared, therefore, that the two-cycle engine still had potential power which had not been tapped.

Blower units . . . Concurrent to the development work with the all-exhaust turbocharging, we have had the mechanically driven centrifugal blower for scavenging the two-cycle engine which provided fuel economies of 7,200 to 7,400 B.t.u.'s. Such a system has perfect starting characteristics.

Unfortunately the pulse system had serious limitations as far as load-carrying ability on the two-cycle engine was concerned when compared to other methods of turbocharging. The constant-pressure system, on the other hand, had limitations in poor starting characteristics and, therefore, had to be supplemented by some mechanical means.

Since the mechanically driven centrifugal blower has perfect starting characteristics, and since the two-stage compression of scavenging air and turbocharging of air is desirable for altitude standpoint, it was only logical to combine the two into one system that we now call series turbocharging.

Tests of various engine designs indicated time and again a basic need for matching the design of the turbocharger to give the highest efficiency operation, free from surge at all loads and speeds.

As could be expected, many complexities had to be solved in evolving the most efficient turbocharger system possible. Some of these were to study the effect of manifold size and cooling of the exhaust manifold, types of outlets from the cylinder to the exhaust manifold, the effects of the centrifugal wheel design and, very important, the effect of after-cooling itself.

Best method . . . From direct observation of actual engines that have been in service for some time now, the feeling is strong that the constant-pressure turbocharger with the engine-driven centrifugal compressor is the best known method for increasing the output of the two-cycle turbocharged gas engine.

Development work has fuurther convinced us that in addition to increased horsepower, fuel consumption can be lowered to a considerable extent depending on which engine the turbocharger is used.

Fortunately, the design of the series turbocharged compressor is such that existing engines can be converted in the field without special tooling or complex assembly. This advantage, of course, opens a wide avenue for boost-

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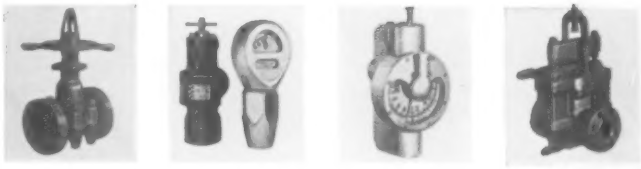

One-man-operated CLEVELAND 190 backfills pipeline *"almost as fast as man can walk"*

Much of this United Gas pipeline from the Chocolate Bayou field to the main line near Webster, Texas cuts through rice-growing farmlands. To avoid interference with the placement of water canals, the 42-inch wide trench had to be dug extra deep—to an average of approximately 7 feet—forming big heavy spoil banks of wet sticky gumbo in many places. Along much of the 16-mile line, the trench also was filled with underground water which seeped in from the rice fields.

In spite of these adverse conditions, a Cleveland 190 backfiller helped Fowler-Tatom Pipeline Contractors keep the job moving at a good rate, leaving no open trench at the end of any day's work. Working right on the heels of the lower-in crew, the one-man-operated 190 tied down pipe in the water-filled trench, then doubled back and completed the fill and finished it off with a neat clean-up job. The job report states, "The Cleveland 190 backfilled trench almost as fast as a man can walk." Because it never has to leave the right-of-way to do any part of its job, the 190 was also a big factor in getting this job done with no off-right-of-way damage.

BUILT FROM THE GROUND UP TO DO ALL YOUR BACKFILLING...BETTER

One-Man-Operated
79 H.P., 467 Cubic Inch Diesel Engine
Perfect Balance, Low Ground Pressure
4 Backfill Line Speeds
Telescopic Boom, 19′ to 27′
Hydraulic Boom Hoist
Hydraulic Steering Brakes
Hydraulic Backfill Clutches
7′ x 3½′ Backfill Board
All speeds (1 fpm to 4.3 mph) in Either Direction

Good Everywhere

THE CLEVELAND TRENCHER COMPANY

20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

ing the capacities of existing compressor stations without the addition of complete engine units. The savings in cost of foundations and station space are obvious. Conversions are being made with only three days' down time.

In continuous operation today are a number of series turbocharged engines. Three such units equipped with series turbocharging are compressing gas at Panhandle Eastern's Seward booster station.

These are type GMVC engine-driven compressors normally rated at 800 hp. each. Although the new rating of these engines with series turbocharging is 1,000 hp., the engines are actually pulling as high as 1,100 hp. without any apparent laboring, on ambient air as high as 95°, and at an elevation of 2,800 ft.

The operation at Seward station is taking residue gas at 500 psi. from a gasoline plant and discharging the gas at 625 psi. into a main transmission line. Each compressor unit handles from 65 to 70 M.M.cf. of gas a day.

Running since September 1955 is a similar engine-driven compressor equipped with series turbocharging; at the Pegasus station of Magnolia Petroleum Co. Originally rated at 1,350 hp. with its mechanically driven scavenger blower, this engine-driven compressor is now pulling up to 1,800 hp. compressing gas for gasoline-plant service.

Fuel consumption is 7,200 B.t.u. per b.hp-hr. at rated load. The engine has remarkably low heat rejection to jacket water of 1,200 B.t.u. per b.hp.-hr.

Low heat dissipation . . . An added advantage of the turbocharged engine with its lower heat dissipation to jacket water permits smaller and less costly heat-dissipating equipment. The GMWA unit with the gear-driven centrifugal scavenger, for example, has a maximum heat dissipation of 1,700 B.t.u. per b.hp-hr. The series turbocharged unit as demonstrated at Pegasus station has a maximum heat dissipation of 1,200 B.t.u. per b.hp.-hr.

Water-cooled exhaust manifolds have been used mostly for station comfort although this particular feature is responsible for about 30 per cent of the heat dissipation and shares that percentage of the cost of the cooling equipment. The turbocharged engine will dissipate some additional heat to the engine room although the manifolds are insulated.

The reason there are no water-jacketed manifolds on the turbocharged engines is to conserve heat energy for the turbine. To be fair to the mechanically scavenged engine, it too may also have dry insulated manifolds. When this is done, the heat dissipation of the mechanically scavenged engine is under 1,200 B.t.u. per b.hp.-hr. and is comparable to the turbocharged engine.

Aftercooling . . . Cooling both by evaporation and aftercooling is beneficial in both fuel economy and load capacity of the engine unit. To this end, a number of research developments are under way for improving the effectiveness of heat exchangers and expansion turbines. **End.**

BOOK

A.S.T.M. MANUAL FOR RATING MOTOR FUELS BY MOTOR AND RESEARCH METHODS. Published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3. 192 pp. Cloth binding. $6.75. Price to A.S.T.M. members, $5.00.

This manual was prepared by A.S.T.M. Committee D-2 on petroleum products and lubricants to: (1) revise and bring up to date the A.S.T.M. methods for determining the knock characteristics of motor fuels by research and motor methods; and (2) to better serve users of A.S.T.M. knock-test engines by providing six appendices presenting by work and picture, factual information and data on the operation and maintenance of the knock-testing equipment.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.

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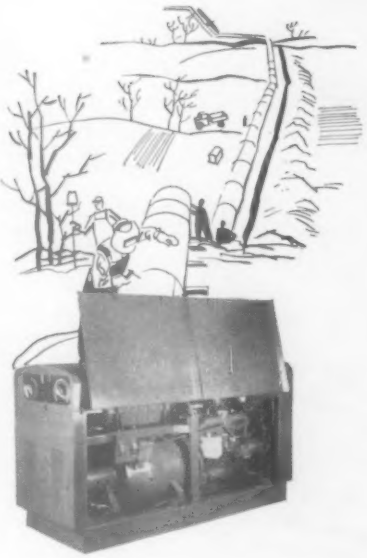

THE LINCOLN ELECTRIC COMPANY

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The World's Largest Manufacturer of Arc Welding Equipment

Up-to-the-minute pipeline upkeep information at a glance

This Record Lets You See

It's there in black and white . . . and in several colors

by J. A. Holloway

HOUSTON PIPE LINE CO. has developed a pipeline-maintenance record which presents all the accumulated records in pictorial form. With this picture before you it's possible to take a visual tour of an entire pipeline in a matter of minutes. You can see all the repairs and maintenance performed over the past years. The record shows when they were made, the exact location, and what condition the pipe is in.

This has greatly simplified the planning of maintenance and has played an important role in evaluating old Houston lines.

Author is superintendent, corrosion section, Houston Pipe Line Co.

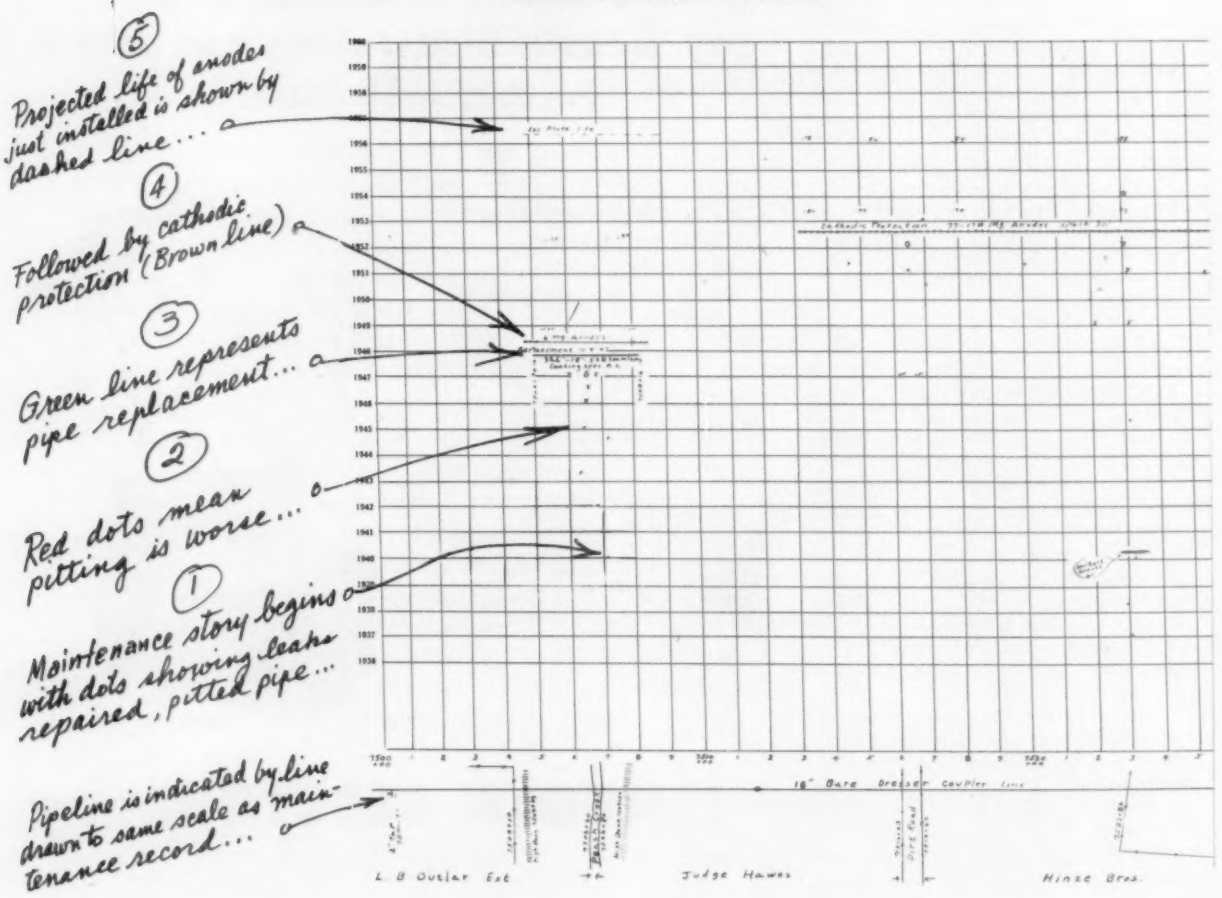
In the early 1940's the company felt the need for a better way of assembling records of repairs on its old bare lines. The goal was a record which would give a time and place relation of repairs and maintenance. It should show the type of work done and the general condition of the pipe from inspections made when leaks were repaired or the line was uncovered for any reason. All these requirements were met by placing easily understandable symbols upon a special graph sheet. The color of the symbol indicated the condition of the pipe and the type of maintenance performed.

Natural Gas—Gas Pipelines

What record shows . . . From this record the engineer can easily make a summary of the replacements or repairs at any location or over the entire line. He can also:

Reading from the bottom up, the story

PIPE CONDITION RECORD


5
Projected life of anodes just installed is shown by dashed line...
4
Followed by cathodic protection (Brown line)
3
Green line represents pipe replacement...
2
Red dots mean pitting is worse...
1
Maintenance story begins with dots showing leaks repaired, pitted pipe...
Pipeline is indicated by line drawn to same scale as maintenance record...
18" Bare Dresser Coupler Line
L. B Outlar Est
Judge Hawes
Hinze Bros.

- See the start and growth of hot spots.
- Spot short sections of line where excessive repairs have been made.
- Count the different types of leaks and the type of repair at any location.
- Determine the necessary beginning and ending station locations when hot-spot replacements are made.
- See the location of cathodic-protection installations, the time they were made, and their value from a visual picture of the reduction of leaks.
- See a complete history of pipe potentials at a glance, where pipe-to-soil potentials were plotted on the log.

The value of such a record increases as the system which it depicts grows older.

Development of Graph

The graph sheets were sheets printed with all the lines very light so the symbols representing the work would stand out. The sheets, expected to be in use for many years, were made from the best grade of ledger paper. Several heavy end-lock sectional post binders were secured to protect the sheets and to keep the record in book form. Indexing was thus made simple and records could be inspected at any location on the pipeline.

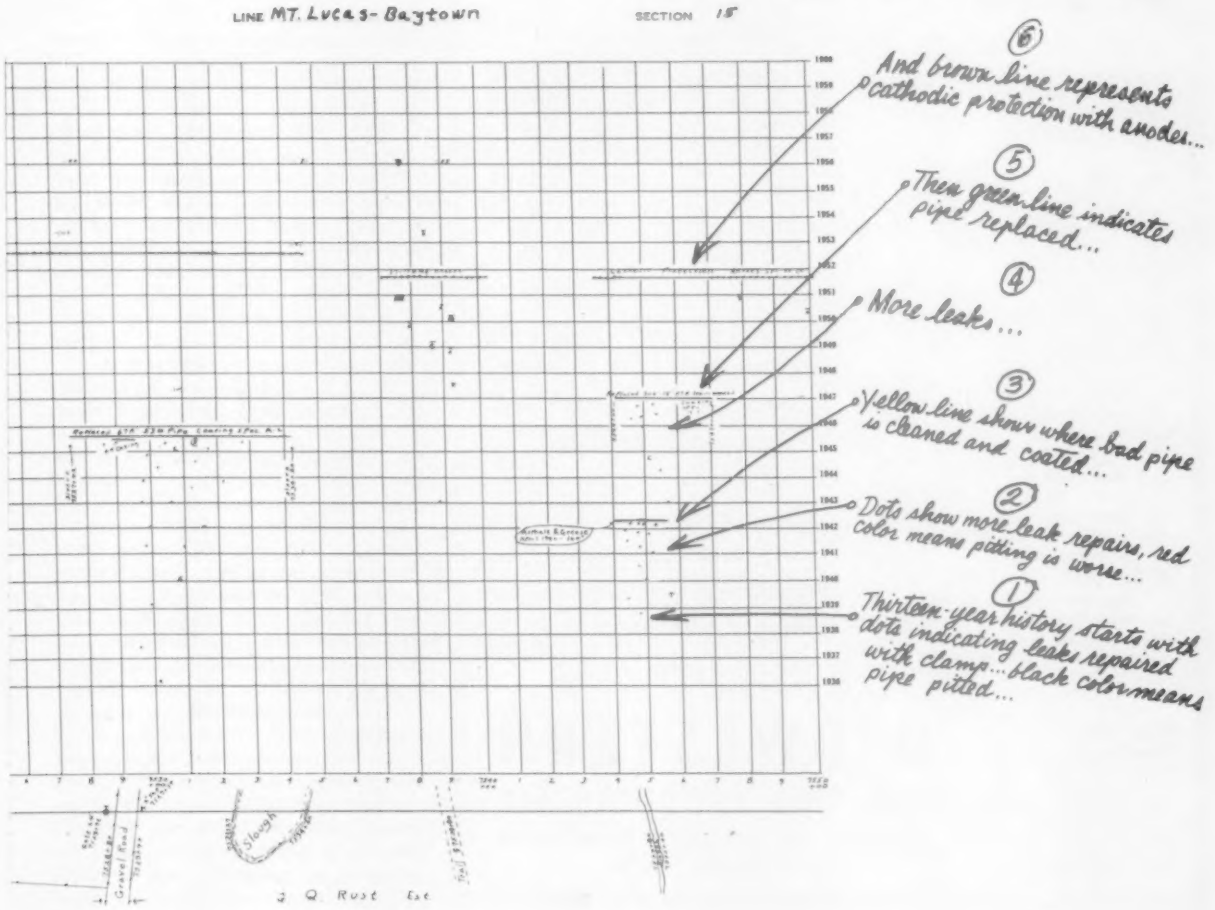
Width of the sheets allows for a 25-year record. They were made as long as would be practical to handle. The sheets measure 14 in. wide and 28 in. long with the graph section actually covering a space 11½ in. wide and 25 in. long. Approximately ¾ in. below the graph section, a heavy black line was printed on the sheet to represent the pipeline. A narrow section of the pipeline map was drawn at the bottom of the sheet.

All fences, creeks, rivers, taps, foreign lines, property owners, etc., were shown just as on the pipeline map. Where the pipeline made a turn, a small circle was drawn on the black line to indicate an angle point.

Graph scale . . . The pipeline scale and the graph scale were made the same so that all information on the graph sheet would be directly above its location on the map. The lines on the graph sheet were made of two colors—faint purple lines for large-scale divisions and faint green lines for small-scale divisions. The small-scale vertical-line spacing was made 1/10 in. with the large-scale lines ½-in. These lines represented footage along the pipeline.

On old bare lines, in order to have plenty of space for posting repairs made at hot spots, etc., a scale of 1 in. equals 200 ft. was selected. Each purple line represented 100 ft. and each green line 20 ft. with each sheet representing 5,000 ft. of pipeline. On coated lines, with fewer repairs likely, the scale could be changed so that each sheet would cover a much greater distance. Approximately 9½ miles would be covered by each sheet at a scale of 1 in. equals 2,000 ft. making each purple line represent 1,000 ft. and each green line 200 ft. At this scale approximately 200 sheets would be required to cover a pipeline 2,000 miles long. At the bottom of the graph, footage indications were placed at each purple line to aid

of its corrosion and its control unfolds in detail


LINE MT. Lucas - Baytown
SECTION 15
6
And brown line represents cathodic protection with anodes...
5
Then green line indicates pipe replaced...
4
More leaks...
3
Yellow line shows where bad pipe is cleaned and coated...
2
Dots show more leak repairs, red color means pitting is worse...
1
Thirteen-year history starts with dots indicating leaks repaired with clamps... black color means pipe pitted...
Gravel Road
Slough
J. Q. Rust Est

in posting information at the correct location along the pipeline.

On the horizontal scale, the first inch was divided into ½-in. sections by faint purple lines and these sections divided into 1/10-in. sections by faint green lines. This section of the graph sheet was made for posting soil resistivity, original pipe potentials, or any information which might be needed in the form of a curve plotted along the pipeline. The next purple line was spaced ½ in. up, leaving a space with no horizontal green lines. This made a division between the lower graph section and the upper section, and also provided a space where a number of years of very old information could be posted close together.

The remaining upper portion was divided into 25 sections by faint purple horizontal lines for indicating years, with each of these divided into quarter-years by faint green lines. The years, represented by the faint purple lines, were printed at each end of the sheet opposite the purple line which it represented. By drawing the graph sheet in this manner, the vertical scale indicated time by quarter-years. The horizontal scale represented the footage along the pipeline in any scale selected.

In order to place the different types of desired information upon the graph sheet, a code of colored symbols was used. These symbols were kept as simple as possible and in a form to be easily understood.

TABLE 1—CODE OF COLORED SYMBOLS

- ● = leak in pipe repaired with a clamp
- s = leak in pipe repaired with split sleeve
- c = leak in coupler repaired with a clamp
- cs = leak in coupler repaired with a split sleeve
- w = leak in weld repaired with a clamp
- P = leak repaired by welding patch on pipe
- sw = leak in spot-weld repaired with a clamp
- cw = coupler-wrap welded on line
- DB = leak repaired in drip barrel
- DR = leak repaired in drip riser
- o = old clamp leaking—repaired
- T = test hole or the line uncovered for any reason, such as tap made, and the condition of the pipe ascertained
- □ = concrete block poured to support or hold pipe

These symbols were posted in one of three colors indicating the condition of the pipe at that location as follows:

Green symbol—Pipe at this location is good (smooth or pitting under 50 mils).

Black symbol—Pipe at this location is pitted (pits 50 to 150 mils).

Red symbol—Pipe at this location is bad (pits 150 mils and over).

Posting of symbols . . . In addition to the leak symbol, a small red VB was placed at any location where the pipe was considered very bad by the men making repairs.

When pipe replacements were made, a green line was drawn on the log sheet at the date the replacement was made and covering the distance which was replaced. Other information about the replacement, such as beginning and ending station numbers, date replaced, footage, size and kind of pipe, coating, reason for replacing, etc., was written on the log sheet adjacent to the green line representing the replacement.

Other colors used in placing information upon the graph sheets were yellow, purple, and brown. Yellow indicated places where short sections of bare pipe were cleaned and coated by the field crews. These were plotted on the graph sheet by drawing a yellow line at the year and location of the coating. Other information about the coated section, such as type of coating, footage, etc., was written on the graph sheet adjacent to the yellow line. Purple was used for special information with an explanation always written on the log sheet.

All cathodic protection was indicated by brown color. Where a magnesium anode was installed at a leak repaired, a short brown line was placed just above the leak symbol. Estimated life of anodes could be indicated upon the graph sheet by a dotted line drawn above the protected section at the year estimated to be the end of their service life. **End.**

V.I.P.*

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Stronger, longer reinforcement of pipe line enamel is the important job of Owens-Corning COROMAT—the only true Fiberglas underground pipe wrap . . . Fibers of glass, bonded with a thermo-setting resin, form a flexible mat, with closely spaced longitudinal reinforcing. Fast and easy to apply, Coromat offers the *most* protection during application and throughout its service.

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Here are a chart and a method
from which you can determine . . .

How Long Will Your Gas Last?

. . . A graphical solution of open-flow-potential method

by R. D. Northcutt

FUTURE availability of natural gas has become a major concern for the gas-transmission companies due to the rapid growth in the demand for gas by their domestic and industrial customers. Because of this rapid growth, the gas-transmission companies are constantly on the search for new sources of gas supply which will enhance their position in meeting the requirements of their customers.

Getting a gas supply is not as simple as it may appear. Once a reserve is contracted for and the contract delivery volumes are agreed to by all parties concerned, these volumes or the producing ability of the wells must be dealt with for the remaining life of the reserves or the primary term of the contract.

Gas volumes to be purchased from the numerous fields connected to a pipeline company's system must fulfill the annual requirements to its customers. The certainty of meeting these requirements could be assured if the producing ability of the wells under contract did not decline below the minimum delivery volume.

The problem thus faced by the engineer is: When will it be necessary to obtain a new gas supply to supplement the declining deliveries in order to fulfill and maintain a constant delivery to the customers?

Finding available gas . . . To solve this problem, it is necessary for the engineer to determine gas availability for each of the fields connected to the pipeline system.

Studies of this type assist the pipeline company's personnel in supporting and justifying the following:

1. Pipeline expansion programs.
2. Pipeline design.
3. Economic studies.
4. Applications of public convenience and necessity.

Determining system-wide gas availability is very complex, expensive, and time consuming. It depends on the number of wells, reservoirs, fields, and gas-purchase contracts being considered. There are several reasonable methods used by engineers in such studies.

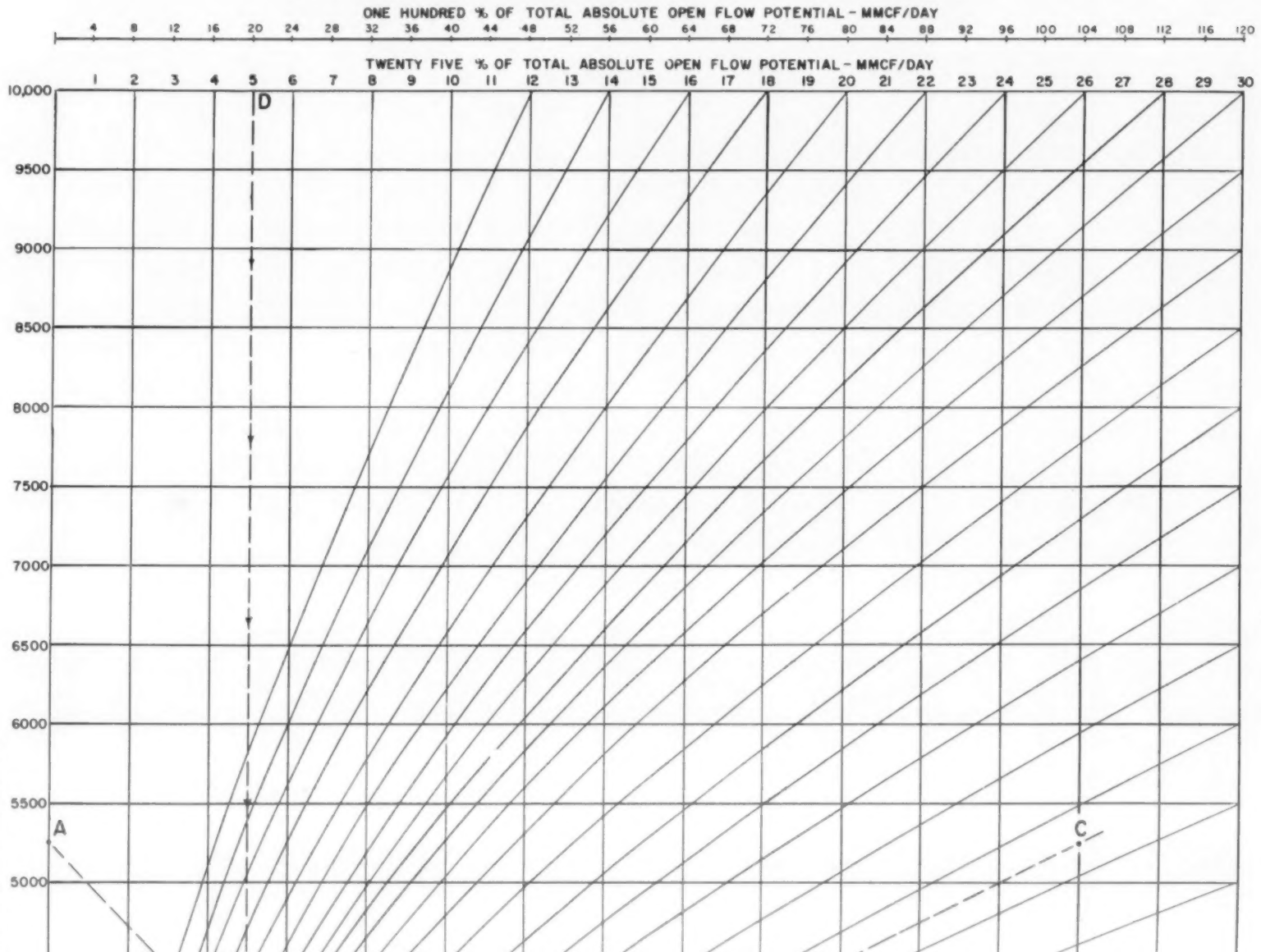
Open-flow potential . . . This method is one means of predicting when a given production rate of a well, or group of wells, will reach a certain percentage of the total open-flow potential—usually 25 per cent. Once the rate becomes 25 per cent of open-flow potential, annual production is decreased so that it remains 25 per cent of open-flow potential. This decrease continues until production rate is equal to a million cubic feet per well per day. If the recoverable reserves have not been depleted by this time, subsequent production is maintained at a rate of 1 M.M.c.f. per well per day until this rate is equal to 50 per cent of the total available potential.

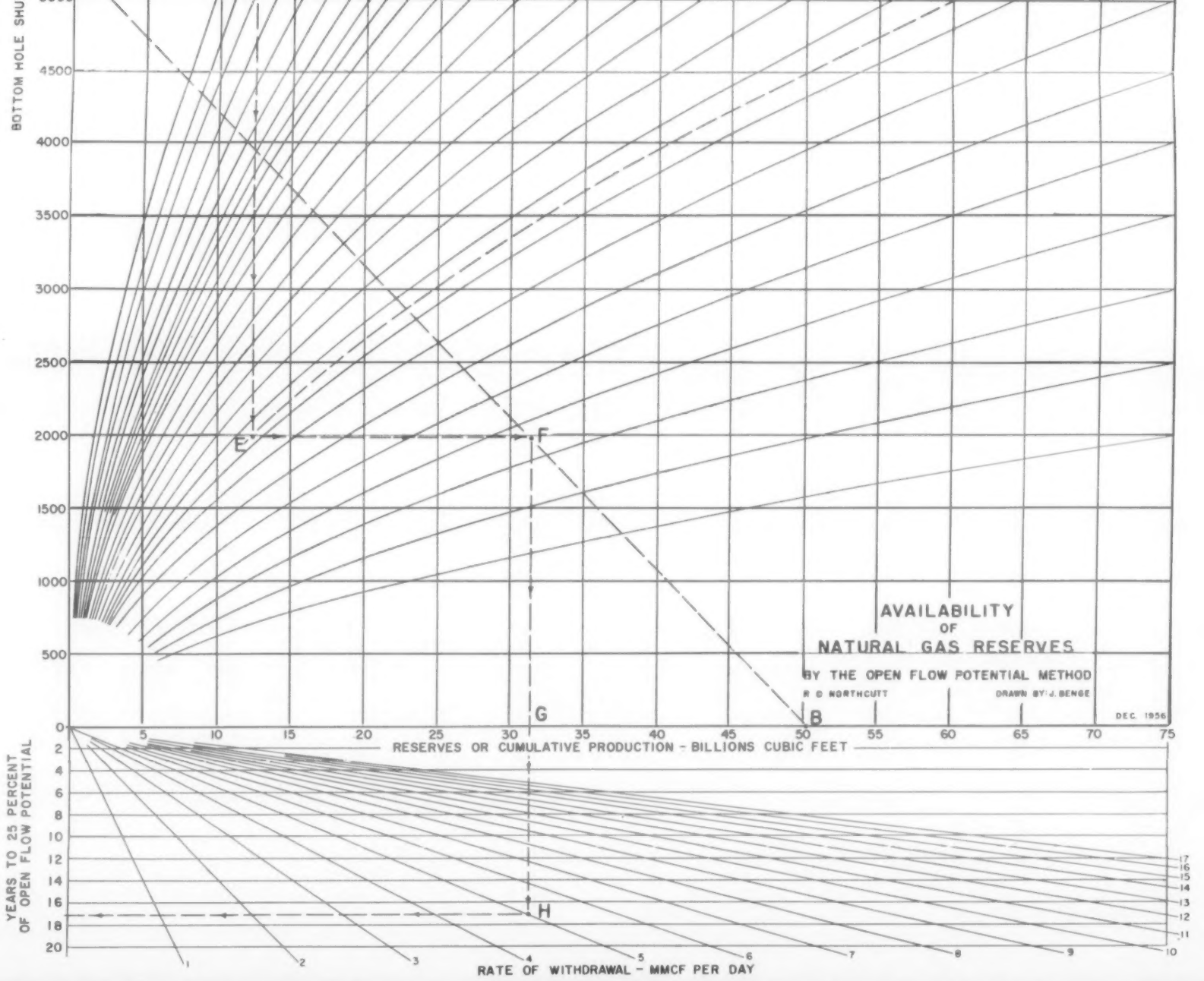
Using this method of determining the withdrawal rate from a field, 50 per cent of the total available potential will never exceed 1 M.M.c.f. per well per day in the declining years of production. Of course this procedure can be modified if production history indicates an unusual trend.

Application of the open-flow-potential method, as outlined above, assumes that all of the reservoirs are volumetric in behavior and will experience a constant pressure drop per volume of gas produced and a decreasing

The author is supervisor-reservoir engineer for Texas Gas Transmission Corp., Houston.

FIG. 2—METHOD OF DETERMINING AVAILABILITY OF GAS RESERVES




BOTTOM HOLE SHU
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AVAILABILITY
OF
NATURAL GAS RESERVES
BY THE OPEN FLOW POTENTIAL METHOD
R. O. NORTHCUTT
DRAWN BY: J. BENGE
DEC. 1956
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RESERVES OR CUMULATIVE PRODUCTION - BILLIONS CUBIC FEET
YEARS TO 25 PERCENT
OF OPEN FLOW POTENTIAL
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RATE OF WITHDRAWAL - MMCF PER DAY

How Long Will Your Gas Last? (continued)

annual open-flow potential. Advantages of a water drive have not been taken into account. Therefore, the gas availability found by the open-flow-potential method is believed to be conservative.

Procedure . . . Fig. 1 presents a convenient form that has been successfully used for the open-flow-potential method of calculation. A sample problem shows the number of calculations needed to find gas availability by this approach.

Fig. 1 shows that a daily rate of 5 M.M.c.f.d. could be withdrawn from this field through the year 1973. At this time, this rate is 22.3 per cent of estimated total potential. In the year 1974, 5 M.M.c.f.d. would be in excess of 25 per cent of the total available potential and therefore the withdrawal rate is reduced so that it remains 25 per cent of the existing open-flow potential.

. . . The graphical method of solving this problem, shown in Fig. 2, presents a shorter way to determine the year when a withdrawal rate will become 25 per cent of the total open-flow potential. The open-flow-potential curves shown on this graph were prepared based on varying pressures and daily volumes using an average slope of 0.85 or 40.5°. Graphs can be prepared to meet any set of conditions by constructing a family of curves based on different slopes or the slope required for solving a specific problem.

The encircled figures on Fig. 1 are the required basic data for solving the problem by the graphical method.

Graphical Solution

Determine: The number of years that 5 M.M.c.f.d. can be produced from this field before this rate is equal to 25 per cent of total open-flow potential.

Required data:

Initial bottom-hole pressure, 5,250 psi. (Point A).

Initial reserves in place, 50,000 M.M.c.f. (Point B).

Initial total open-flow potential, 104,000 M.c.f.d. (Point C).

Daily withdrawal rate, 5,000 M.c.f.d. (Point D).

Solution:

1. Position the required data on Fig. 2 as indicated by Points A, B, C, and D.
2. Connect with a straight line Points A and B.
3. Locate graphically Point C using the total open-flow potential and initial bottom-hole pressure as coordinates. Sketch a curve through Point C positioned proportionally to the family of curves illustrated.
4. Starting at the top of the graph (Point D) opposite 5 M.M.c.f.d., drop vertically to the open-flow-potential curve Point E. Proceed horizontally to Point F and from that point drop vertically to Point G. Point G indicates the cumulative production when 5 M.M.c.f.d. will equal 25 per cent of the total available potential.
5. From Point G, drop vertically to Point H (rate of withdrawal 5 M.M.c.f.d.), then proceed horizontally to the left and read the number of years of availability. The result is 17 years.

A comparison of the two methods indicate the results to be similar. Both approaches to the problem indicate that the withdrawal rate would equal 25 per cent of the total open-flow potential in the year 1974. At this point, the bottom-hole pressure would be approximately 2,000 psi. (determined by Point E) after production of 31.4 billion cubic feet from the three reservoirs. Even though the results obtained by the two methods are relatively the same, there is no comparison as to the amount of time required in the preparation of an availability study using the approach outlined, Fig. 1 vs. Fig. 2.

The graphical approach (Fig. 2) provides an accurate and a more rapid solution to availability problems, especially when analyzing the results of various flow rates, number of wells to be drilled, and the total open-flow potential required. A graph similar to Fig. 2 based on known data for a particular gas storage field would be of value in determining how long a specific flow rate could be maintained and what effect this flow rate would have on the cushion pressure and open-flow potential of the storage reservoir.

(See chart on the back of these pages)

Fig. 1—Tabular Method of Determining Availability of Gas Reserves. Graphical Method (Fig. 2) Is Much Simpler

TEXAS GAS TRANSMISSION CORPORATION
AVAILABILITY STUDY

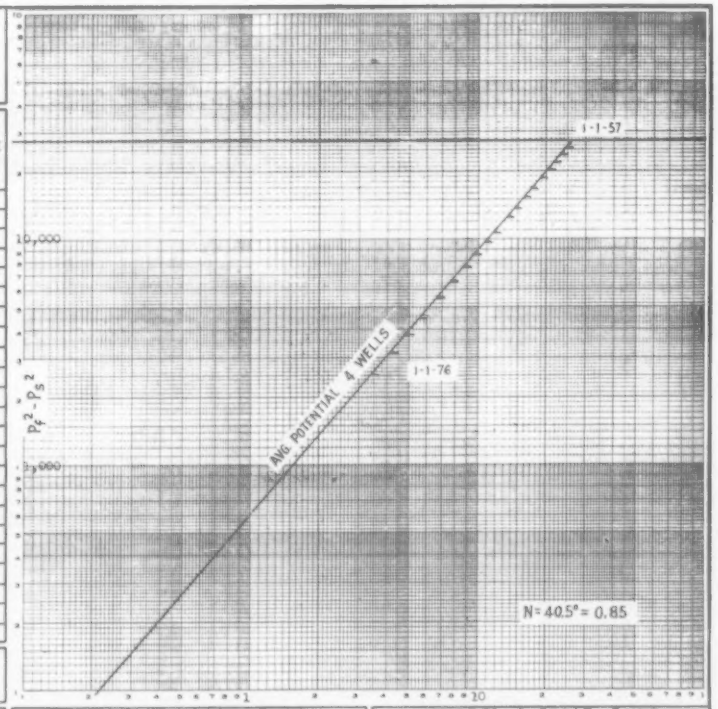
FIGURE 1

FIELD:

DATE: JANUARY 1, 1957

DATE	B.H.P. @ OF YEAR PSIA	P_f^2 (Thds)	POTENTIAL OF AVG WELL @ OF YEAR	NO. OF WELLS	TOTAL POTENTIAL @ OF YEAR MCF	% OF POT PROD	GAS WELL GAS PRODUCED: DAILY MCF	ANNUAL MMCF	CUMULATIVE MMCF	C.H.G. AVAILABLE MMCF	TOTAL GAS AVAILABLE MMCF
INITIAL	5250	27,563	26000	4	104,000	-	-	-	None	None	None
19 57	5250	27,563	26000	4	104,000	-	5000	1850	1,850	"	1850
19 58	5056	25,563	24900	4	99,600	-	5000	1850	3,700	"	1850
19 59	4861	23,689	23000	4	92,000	-	5000	1850	5,550	"	1850
19 60	4667	21,781	21900	4	87,600	-	5000	1850	7,400	"	1850
19 61	4473	20,008	20500	4	82,000	-	5000	1850	9,250	"	1850
19 62	4279	18,310	19000	4	76,000	-	5000	1850	11,100	"	1850
19 63	4084	16,672	17000	4	68,000	-	5000	1850	12,950	"	1850
19 64	3890	15,132	16000	4	64,000	-	5000	1850	14,800	"	1850
19 65	3696	13,660	14500	4	58,000	-	5000	1850	16,650	"	1850
19 66	3502	12,264	13300	4	53,200	-	5000	1850	18,500	"	1850
19 67	3308	10,943	12000	4	48,000	-	5000	1850	20,350	"	1850
19 68	3113	9,691	10900	4	43,600	-	5000	1850	22,200	"	1850
19 69	2919	8,521	9700	4	38,800	-	5000	1850	24,050	"	1850
19 70	2725	7,426	8700	4	34,800	-	5000	1850	25,900	"	1850
19 71	2530	6,401	7600	4	30,400	-	5000	1850	27,750	"	1850
19 72	2336	5,457	6600	4	26,400	-	5000	1850	29,600	"	1850
19 73	2142	4,588	5600	4	22,400	22.3	5000	1850	31,450	"	1850
19 74	1948	3,795	4880	4	19,520	25.0	4880	1782	33,232	"	1782
19 75	1761	3,101	4180	4	16,720	25.0	4180	1526	34,758	"	1526
19 76	1600	2,560	3500	4	14,000	28.6	4004	1461	36,219	"	1461
19							Remaining Reserve		6,281	"	
19	800	Abandonment Pr.									
					Totals			36219	42,500		36219

FACTOR = $\frac{5,250^{\#}}{50,000 MMCF}$ = .105000



CONTRACT OBLIGATIONS

VENDOR	MAX. MCF/D	MIN. MCF/D
Producer (x)	7700	5000
TOTAL	7700	5000

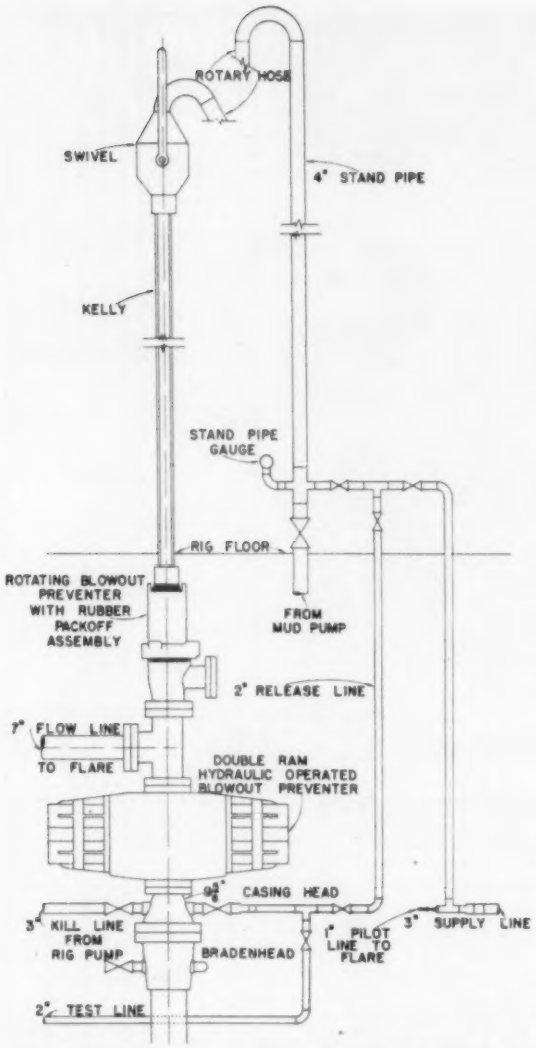
RESERVOIR OR FIELD	INITIAL GAS IN PLACE MMCF	CUM. PROD. MMCF	REMAINING GAS IN PLACE MMCF	INITIAL RECOVERABLE GAS - MMCF	REMAINING RECOVERABLE GAS - MMCF
Zone A	15,000	None	15,000	12,750	12,750
Zone B	21,000	None	21,000	17,850	17,850
Zone C	14,000	None	14,000	11,900	11,900
	50,000			42,500	42,500

POTENTIAL OF AVERAGE WELL

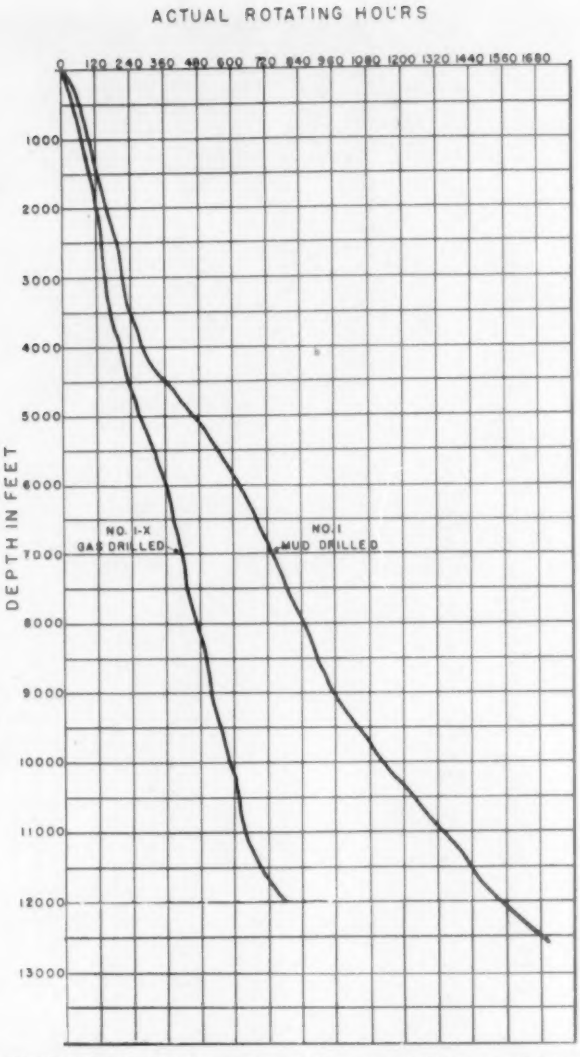
POTENTIAL	NO. OF WELLS	TOTAL POTENTIAL
30,000	1	30,000
25,000	1	25,000
24,500	2	49,000
AVG. 26,000	4	104,000

WEIGHTED AVERAGE B.H.P.

INITIAL GAS IN PLACE	INITIAL B.H.P.	PRODUCT
15,000	4115	61,725
21,000	5350	112,350
14,000	6316	88,425
50,000	5250	262,500



EQUIPMENT HOOKUP included ram-type and rotating blowout preventers. Gas pressure in standpipe varied from 250 to 350 psi. while 3½ to 4½ M.M.c.f. per day was circulated. Fig. 1.



TIME REDUCTION of more than half was gas drilling's record below 5,694 ft., the depth it began. The two wells were located only 100 ft. apart. Fig. 2.

Gas Drilling Pays Off in Deep Delaware Basin Test

Here's how gas drilling was used to a depth of 12,500 ft. Compared to mud drilling on an adjacent well, these were the advantages:

- Rotating hours cut 54 per cent.
- Number of bits reduced 68 per cent.
- Drilling cost 60 per cent less.

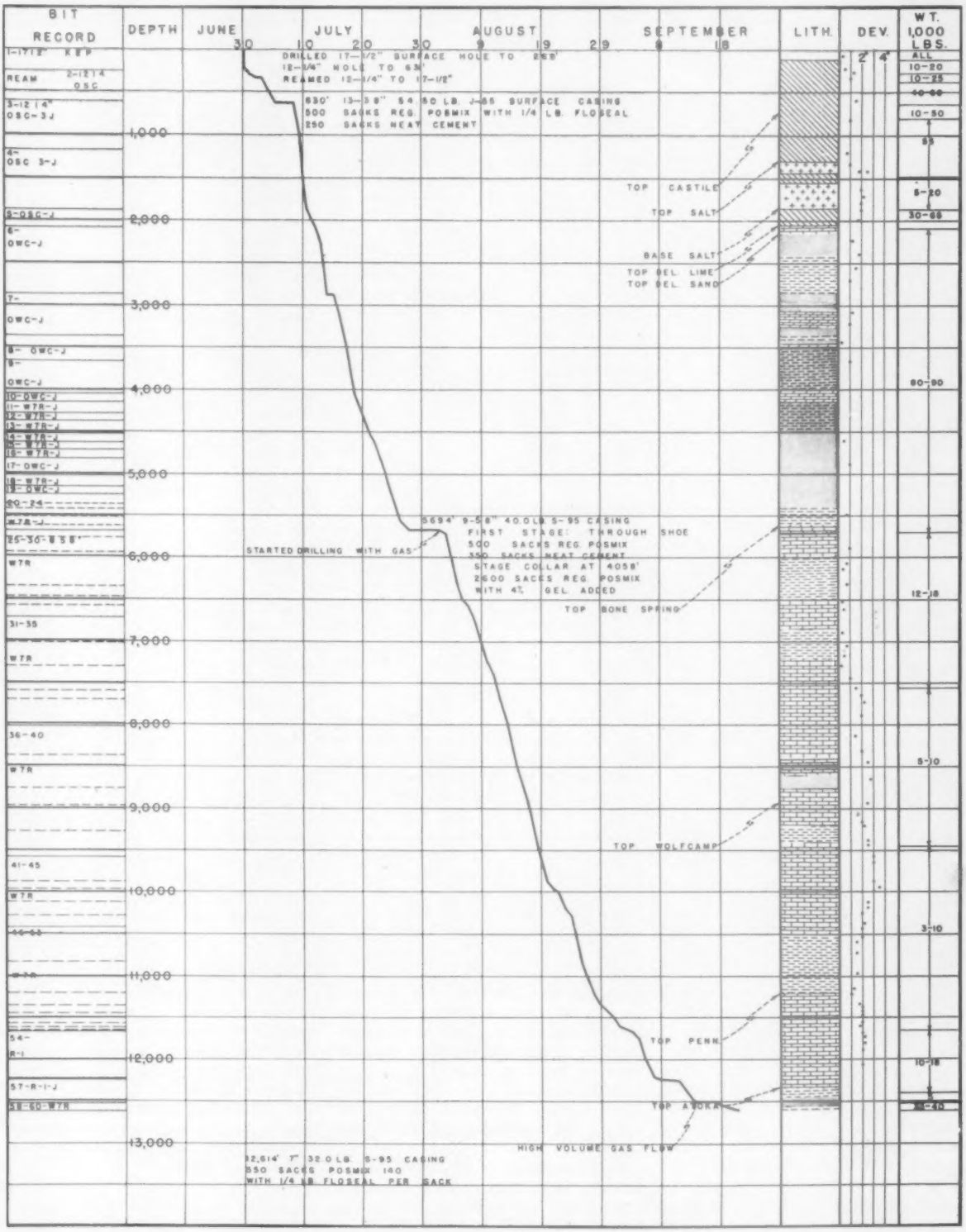
by Loyd R. Baskin

EL PASO NATURAL GAS CO.'S recent success in drilling its Welch Unit No. 1-X well with natural gas as a circulating medium indicates considerable savings where conditions permit this method to be used. Gas drilling started from under an intermediate string of casing at 5,694 ft. and continued to a depth of 12,506 ft. Tremendous savings were realized because of longer bit life, increased penetration rates, avoidance of lost-circulation problems, and elimination of drill-stem tests.

Author is with El Paso Natural Gas Co., Jal, N. M. Paper presented at the 1957 spring meeting of the Southwestern District, A.P.I. Division of Production, Dallas, under the original title, "Deep Drilling With Gas in the Delaware Basin."

DRILLING

Gas drilling . . . longer bit life, faster penetration, no lost-circulation problems, immediate formation testing.



DRILLING WITH GAS was particularly favorable for drilling the hard lime, shale, and chert sections of the Bone Spring, Walfcamp, and Pennsylvanian formations. Note the hard-rock bits used. Weight on bit was light. Fig. 3.

Location . . . The Welch Unit 1-X is located in 21-26s-27e, Eddy County, New Mexico, in the Delaware basin. Geological information available from the previously abandoned No. 1 well, located 100 ft. west of the 1-X, offered an excellent study of the lithologic characteristics of the area and operational problems to be expected. Records showed that a three-string casing program would be adequate for completion and permit gas drilling below the intermediate string of casing.

Gas drilling appeared particularly favorable for drilling the hard lime, shale, and chert sections of the Bone Spring, Wolfcamp, and Pennsylvanian formations. Gas was readily available from the company's 26-in. line, which was less than 2 miles from the location.

Drilling program . . . The 1-X was spudded June 30, 1956, by Great Western Drilling Co., of Midland, Tex. A 17½-in. hole was drilled to 630 ft., using a high-viscosity fresh-water mud. At this depth 13⅜-in. 54.50-lb. per ft. grade J-55 surface casing was set and cemented. Cement was circulated to surface. Six days were required to drill, ream, and run surface casing.

Drilling operations were resumed after 36 hours waiting for surface cement to set. Relatively high bit weights up to 90,000 lb. were used to drill a 12¼-in. hole to a depth of 5,694 ft. Salt-base mud with a diesel-oil additive was used. At this depth, 9⅝-in., 40-lb. per ft. grade S-95 intermediate casing was set using a two-stage cementing procedure. This method was selected because minor lost-circulation difficulties were encountered in the lower portions of the hole. The lower stage consisted of 500 sacks of regular pozzolanic cement and 350 sacks of neat cement. After this, the stage collar, which was set at 4,058 ft., was opened; and the upper hole circulated 6 hours. Then 2,600 sacks of regular pozzolanic cement with 4 per cent gel were placed for the upper stage. Temperature survey showed top of cement at 1,240 ft.

Rigging for gas . . . While cement was setting, preparations for gas-drilling operations began. A double-ram hydraulically operated 10-in. 1500-series blowout preventer was attached to the 9⅝-in. casing spool. A 7-in. flanged outlet on a tee placed above the blowout preventer connected the 7-in. drilling-gas discharge line. On top of the tee was placed a 10-in. series 900 rotating blowout preventer with rubber packoff assembly and hex kelly drive.

The gas discharge line was about 250 ft. long. All drilling gas was flared to avoid accumulation of fumes near drilling equipment. A pilot light installed at the end of the discharge line automatically relighted the flare after the gas had been turned off for connections and trips. Formation samples were secured from a trap placed on the 7-in. discharge line.

Connecting the gas-supply manifold to the standpipe provided conventional circulation of the drilling gas. This manifold was equipped with necessary valves to control the supply of drilling gas and to release pressure on the drill pipe for connections and trips. Fig. 1 shows the gas-drilling assembly used on the Welch Unit 1-X.

Starting gas drilling . . . An 8⅝-in. hole was gas-drilled by circulating gas down the drill pipe, up the annulus, and out the discharge line. A standard float assembly above the bit prevented the backflow of drilling gas during connections. In addition, it served to prevent any formation gas encountered flowing through the drill pipe.

Above the bit as many as seven 7-in. drill collars were used, with the remainder of the drill string being made up of 4½-in. 16.60-lb. per ft. grade E, external-upset drill pipe. As drilling progressed it became necessary to use a heavier 20-lb. per ft. drill pipe in the upper portion of the string because the weight approached the limit allowed to prevent crushing action by the slips. There was evidence of very slight abrasive action on the upset of the tool joints because of constant circulation of gas and cuttings.

Gas operations . . . Average pressure on the standpipe during the gas-drilling operations was maintained between 250 and 350 psi. These pressures were sufficient to circulate a volume of 3½ to 4½ M.M.c.f. per day. The volume circulated was maintained as low as possible to prevent excessive flaring of gas. However, with varying hole conditions it was necessary to increase the rate of flow to clean the well bore of cuttings and to overcome minor fluid entries.

In portions of the Permian and Pennsylvanian shale sections, it was necessary to discontinue drilling and continue circulating from 12 to 18 hours in order to completely clean the well bore of heaving shale. Fig. 2 is a graphic comparison of actual rotating hours for the gas-drilled Welch Unit 1-X vs. the conventionally mud-drilled No. 1 well.

Large quantities of very fine-textured cuttings were easily secured from the trap on the gas-discharge line. Experienced geologists, with the aid of a microscope, were able to determine the character of the formations being drilled. Lag time was approximately 3 minutes at 12,000 ft.; therefore, an immediate indication of any lithologic change was evident in samples. Simply by shutting off the drilling gas supply and measuring formation gas produced, a thorough test of gas encountered could be made.

Fig. 3 is a graphic representation of the drilling operations performed on the Welch Unit 1-X.

As compared to conventional mud-drilling operations, weight on the bit of 3,000 to 18,000 lb. was relatively light. Maximum hole deviation reached during the gas drilling was 3°, and at no time was it necessary to use a stabilizer to maintain a reasonably straight hole. All fishing jobs were of a routine nature, and there were no particularly difficult problems encountered.

Bits . . . All bits used during gas drilling were conventional bits of the tricone design for drilling hard-rock formations. Two tricone bits with tungsten carbide inserts were successfully used to drill the extremely hard lime and chert sections penetrated in the Pennsylvanian formation.

While drilling the 6,812 ft. in the Welch Unit 1-X with gas, 33 bits were used and 507 actual rotating hours were needed to drill the hole. In the nearby Welch Unit 1, 103 bits and 1,115 actual rotating hours were required. Actual rotating hours for the mud-drilled and gas-drilled holes are graphically shown in Fig. 2.

In the gas-drilled section the average bit drilled 206 ft.; whereas in the mud-drilled well, the average bit drilled only 67 ft. in the same interval. This represents a 200 per cent increase in footage per bit. The higher penetration rate and longer bit life made it possible to drill the same amount of hole with 70 fewer bits and 608 fewer actual rotating hours. Because many trips with the drill pipe were avoided by the use of fewer bits, the gas-drilled well represented substantial savings in rig time.

Completing the hole . . . As drilling progressed, two temperature surveys were run to determine points of gas entry into the well bore. At a depth of 12,506 ft. a large volume of high-pressure formation gas was encountered, and it was necessary to mud up the hole to safely continue drilling operations. Mudding up was accomplished with a minimum of difficulties, and conventional mud drilling was resumed.

The well was drilled to a total depth of 12,620 ft. at which point electric and radioactive logs were run. Then 7-in. 32-lb. per ft. grade S-95 casing was set and cemented with 550 sacks of pozzolanic cement.

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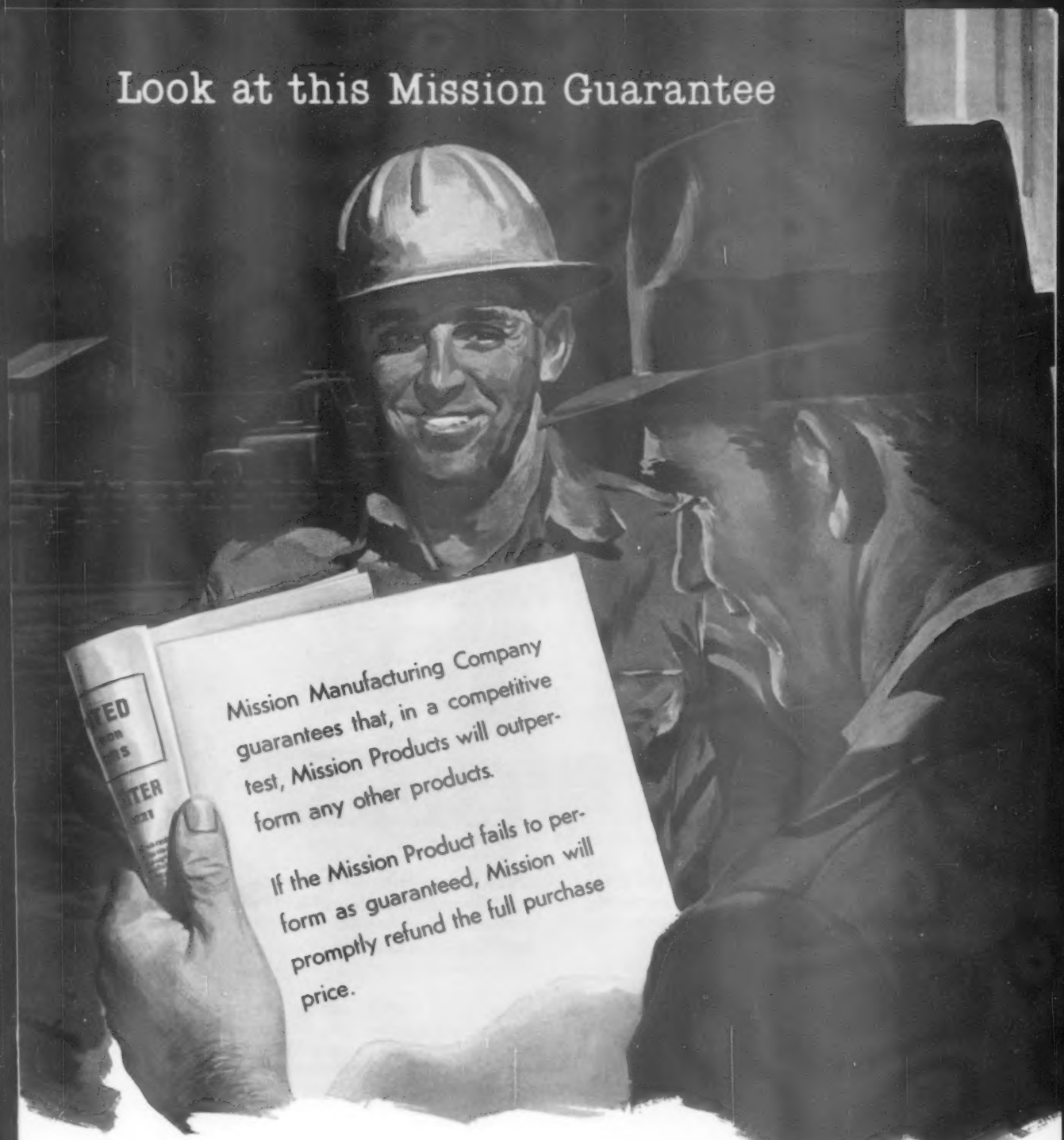
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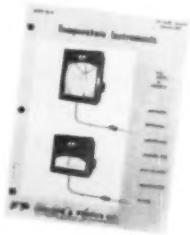

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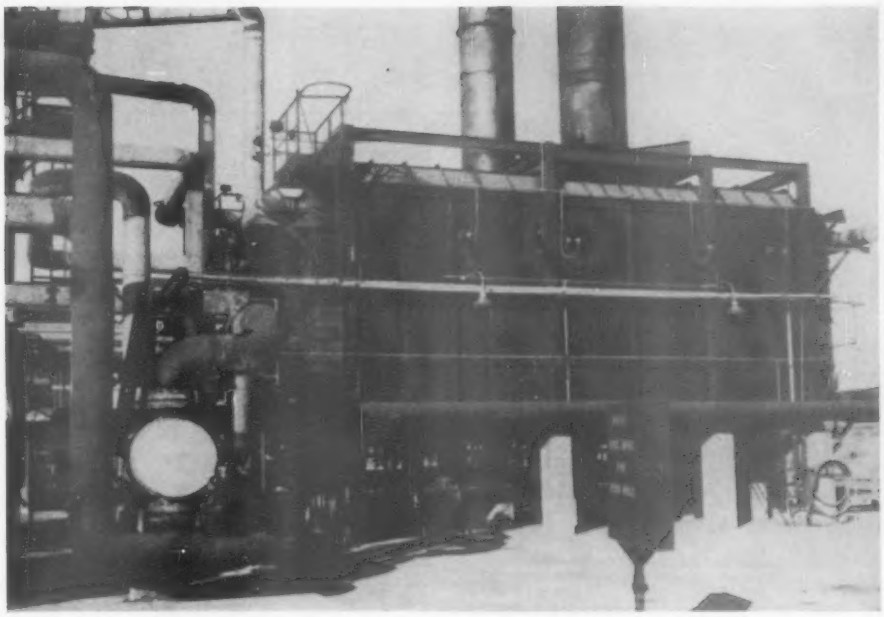


THE UNIT is now on stream after successful acid cleaning. Hottest reaction mix heat exchanger is in left foreground.

Cat Reformer Gets an Acid Bath

Scale thoroughly removed, and H_2S safely disposed of

by Donald M. O'Neill

IRON sulfide scale can be effectively removed from a catalytic reforming unit by acid cleaning. This is the experience of Standard Oil Co. of Texas in working with a 5,000-bbl. per day platinum-catalyst reforming unit at its El Paso, Tex., refinery. The unit has no sulfur-removal facilities, either for the feed or for the recycle gas.

By carefully planning the cleaning operation and taking the proper safety precautions, the job was done easily and quickly. The primary safety problem was the disposal of hydrogen sulfide, evolved when the acid dissolved the iron sulfide. This noxious gas was safely burned in the furnace of the thermal cracking unit, where it was diluted with the hydrocarbon fuel before combustion.

Inspections of the unit at several points and audigager checks of a number of furnace tubes showed no evidence of scale after cleaning.

Author is refinery engineer, Standard Oil Co. of Texas, El Paso. Paper presented at Dowell Incorporated refinery symposium, Tulsa.

Amount of scale . . . Before acid cleaning was attempted, the unit had been operated about 13 months. From scale measurements taken at previous shutdowns it was estimated that the feed preheater and intermediate heaters had ⅛ in. of scale on the inside of the tubes. The hottest reaction mix feed heat exchanger was thought to have ⅛ in. of scale on both the inside and outside of the tubes.

It was estimated from these findings that the system contained approximately 63 cu. ft. of scale. X-ray diffraction analysis had shown that the scale was essentially pure FeS. Approximately 80,000 std. cu. ft. of H_2S would be formed on solution of this scale with hydrochloric acid.

In acid cleaning of this unit, it is essential that the unit be cleaned safely, and that a complete job of scale removal be done.

REFINING

Disposal of H_2S

The safe disposal of 80,000 cu. ft. of H_2S requires extensive planning and the proper facilities. Several alternative methods of H_2S disposal were considered:

1. Release the H_2S directly to the atmosphere from a vent line on the depropanizer column, at an elevation of approximately 75 ft. above plant grade.

2. Flare the H_2S on top of the depropanizer column approximately 75 ft. above plant grade.

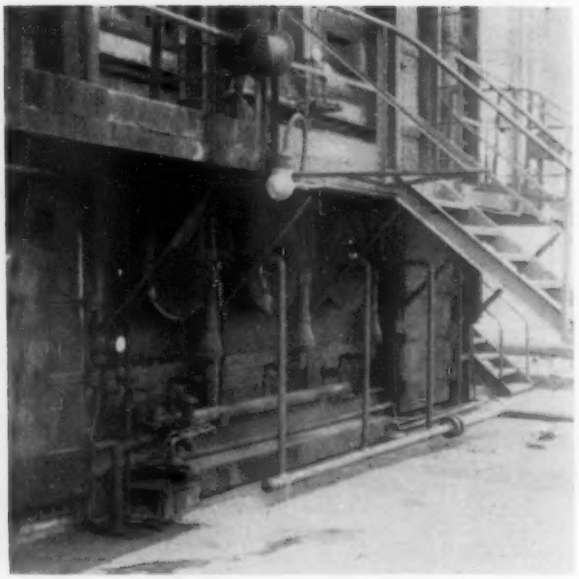
3. Release the H_2S formed into the refinery low gas system. This system is old and rather complicated as it has been expanded several times since it was first built. A small 100,000-cu. ft. gas holder rides on this low gas system.

4. Caustic scrub the gas formed during the acid cleaning operation.

5. Burn the H_2S in the thermal cracker furnace along with other fuel gas required for the thermal cracker heat load.

In considering the various possible

TEMPORARY MANIFOLDS installed for the cleaning. Acid-dilution and heating piping in foreground; flow-reversing manifold in background.



TEMPORARY LINE to thermal cracker furnace for H_2S disposal. Three risers enter the furnace through the three large circular burners.

methods of disposal, the toxicities of H_2S and its combustion product, SO_2, were given due consideration. The toxicities for these two gases are:

TOXICITY OF GASES (ALL FIGURES P.P.M.)

	Rapidly fatal	Max. conc. ½-1 hr.	Max. conc. 1 hr.	Max. conc. for prolonged exposure
H_2S	1,000-3,000	500-700	200-300	20
SO_2	400-500	50-100	.....	10

In considering the alternative H_2S-disposal methods we planned to control the quantity and strength of acid, to restrict the evolution of gas to a maximum rate of 20,000 std. cu. ft. per hour. All design calculations for the disposal system were based on this maximum rate.

Toxic gases . . . Because of the high toxicity of H_2S and SO_2 it was felt that neither of the first two methods of disposal of H_2S was acceptable. Because of the complexity of our refinery low gas system and because of the possibility of small leaks occurring in this system, it was felt that a dangerous local H_2S concentration could occur almost any place within the refinery. For that reason this method of disposal was rejected.

Caustic scrubbing of the gas from the acidizing operation had two serious disadvantages. We felt that this did not permanently assure us of having eliminated the hazard. With our waste-disposal ponds, there is the remote possibility of the sodium sulfide formed by the scrubbing being contacted at a later date with acid, thus releasing hydrogen sulfide. The second disadvantage was that we did not have an adequate caustic scrubbing system readily available to handle the H_2S at the expected evolution rates.

Burning the hydrogen sulfide in the thermal cracker furnace along with the incremental normal fuel-gas requirements had important advantages. The SO_2 formed on combustion of the hydrogen sulfide would be considerably diluted with other flue gases from the furnace, it would be released at a high elevation above the plant, and it would be released at a considerably higher temperature so that the gas would tend to rise and be dispersed in and diluted by the atmosphere.

SO_2 concentration . . . However, calculations showed that the flue gas leaving the thermal cracker furnace during the acidizing operation would contain approximately 2 per cent by volume of SO_2 when the H_2S was being burned at maximum rate. Calculation methods from two separate articles were used to independently check the concentration SO_2 that might exist at ground level under these conditions.

The first of these articles was entitled "Stacks for Pollution Control" in Chemical Engineering, February 1952. The other article used was titled "Dispersion of Gases from Tall Stacks" by Thomas, Hill and Abersold from Industrial & Engineering Chemistry, November 1949. Both of these references used basic equations originally developed by Bosanquet and Pearson. Calculations using these two sources showed that the concentration of SO_2 at ground level would be well within safe limits.

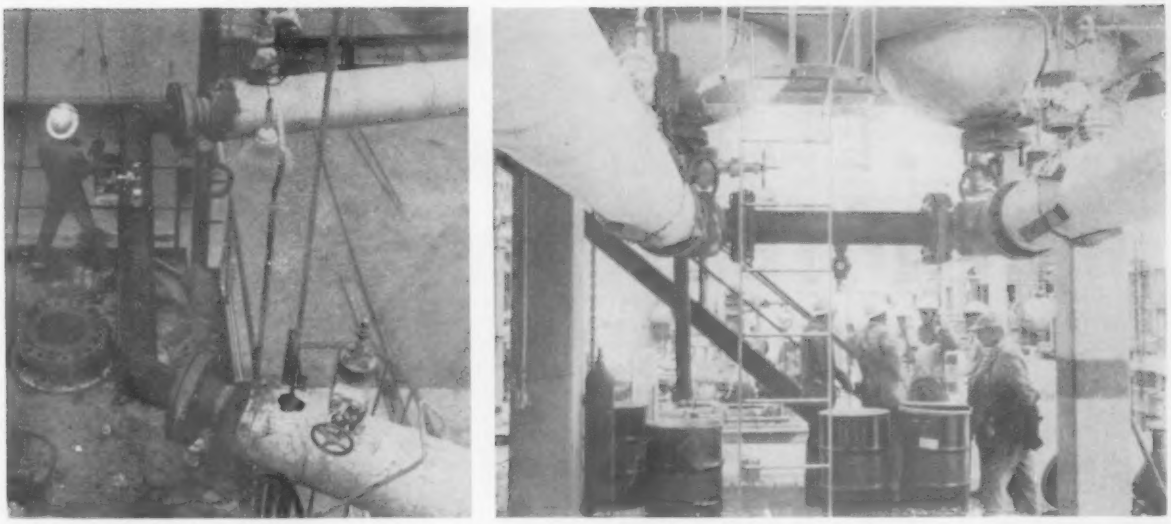
We were still concerned with possible hazard to personnel on elevated structures around the refinery, particularly on the Houdry cat cracker structure which was within 500 ft. directly west of and taller than the thermal cracker stack. To reduce hazard to personnel at this point, orders were issued for any operator who went up on the structure during the cleaning to have a canister-type gas mask with him at all times.

Provision was also made for any man going up on the structure to wear a self-contained emergency air supply, with air mask available for instant use should he encounter any concentration of SO_2 gas.

Safety Precautions

It was considered essential to inform the men, both in the area and in the surrounding plants, about the cleaning operation. A memorandum was issued over the refinery manager's signature, describing the operation, the available safety equipment, and other pertinent information. Temporary flow meters were provided to meter the flow of H_2S going to the thermal cracker furnace, so that release rate could be maintained within the desired maximum.

The depropanizer column of the catalytic reformer was used as a surge vessel during the acidizing operation. It was selected because it was large



THESE TEMPORARY JUMPOVERS were installed to bypass the reactors and form a continuous circulating system of the three furnaces.

enough to contain acid equal to the entire volume of the system being acidized. Therefore, should the reaction get out of hand at any time, the depropanizer column could handle all the liquid in the system. The gage glasses on the bottom section of the column were replaced with tubular gage glasses without check valves. This was done in order to reduce the chance of reading a false level because of plugging.

A public-address system was installed in the area for the shutdown, so that it would be possible to give immediate instructions to all personnel working in the area in case of a serious leak or other emergency conditions. The complete acid cleaning system, including all temporary lines and equipment, was hydrostatically tested, blown out with air, and displaced with nitrogen to make sure there was no explosive mixture occurring during the initial gas-evolution period.

The Cleaning Operation

Laboratory tests were run at 100° F. on scale samples removed during a previous shutdown, using HCl of 5 to 25 per cent concentration. Results showed that initial contacting should be done with acid at no higher than 10 per cent concentration. As gas-evolution rate decreased, acid strength would be increased and the acid heated to a maximum of 160° F. To assure a complete job, 20 per cent acid at 160° F. was to be circulated for 1 hour.

Cleaning started . . . Actual acidizing was started by slowly charging 10 per cent acid into the system, circulating, and then dropping spent acid at a concentration of about 2½ to 4 per cent. This process was followed for approximately 2 hours. During this time the H_2S was being produced in surges ranging up to a maximum rate of about 12,000 std. cu. ft. an hour. No heat was added during this initial period of cleaning. Solution temperatures were in the neighborhood of 85° to 90° F.

After 2 hours of acidizing, the acid strength was increased to 13 per cent, with acid being continually pumped into the system. Spent acid at about 3 per cent concentration was dropped continuously to disposal. Control over this operation was maintained by watching the gage glass on the depropanizer.

Within a few minutes it was noted that the depropanizer bottom pressure had risen to about 15 psi., which indicated either that the level had risen in the depropanizer column or that the pressure drop in the gas-disposal line to the thermal cracker furnace had gone up due to increased gas production. However, the level was still visible on the gage glass and a check of the gas flow showed that the H_2S production had not increased significantly.

Within a minute or two large clouds of yellowish-white smoke were being emitted from the thermal cracker stack. Acid was reported in the gas line into the furnace. Pumping was stopped immediately, and spent acid was drained from the system as rapidly as possible. The pressure at the bottom of the depropanizer column reached the maximum of about 35 psi. Of course, the gas quantities indicated by the meter during this period were not correct because of the acid carryover. It was finally determined that the gage glass had become plugged and was not indicating a true level.

As nearly as could be determined afterwards, the quantity of acid in the system at the time when acid started to carryover into the furnace was less than the volume of the depropanizer column. Apparently a high level had built up in the depropanizer column and a rapid release of gas below the surface of this acid had caused the column to flood, with acid being carried over into the system going to the furnace.

From this time on the gage glass was not used to control the acid level. Instead, two pressure gages were used, one on the bottom of the depropanizer column and one on the gas knockout drum in the line to the thermal cracker furnace. The difference between these two pressure-gage readings was used to indicate approximately the level of liquid in the depropanizer column. Although the gage glass was unplugged and placed back in operation, it again became plugged showing that the use of the pressure gages was more reliable for level indication.

Stronger acid . . . Circulation of the system was started again about 3 hours later. Ten to 12 per cent acid was charged, circulated, and removed when spent to about 2 to 4 per cent. During this period small surges of H_2S up to a maximum rate of 3,000 to 4,000 cu. ft. per hour were given off, indicating a greatly reduced activity. Two hours later, the 10 per cent acid was heated with open steam up to 160° F. and circulated. There was very little activity during this period over the next 2 hours.

At this time it was decided that the cleaning operation was essentially complete. To make absolutely certain, 2,000 gal. of 20 per cent acid was charged into the system, with enough 10 per cent acid being removed to make room for this addition. This acid was circulated and heated to 160° F. There was

no evidence of gas release shown on the meters. When the acid had become thoroughly mixed, concentration leveled off at about 18.5 per cent.

Acid circulation was then reversed and another sample taken for titration after about 30 minutes. This sample showed a concentration of 13.5 per cent. Circulation continued, with additional samples taken at about 15-minute intervals. The samples all showed the concentration to be approximately 13.5 per cent.

Apparently when the circulation was reversed the last time, a pocket of unreacted material had become exposed to the acid, causing the drop in the strength of the acid in the system. Because the meters were sized for relatively high flow rate, there was no indication of gas production during this period. Three hours after the first addition of 20 per cent acid, more was added to bring the strength of the system back up to about 16½ per cent. This was circulated forward and backward through the system for about an hour and a half at a temperature of 160° F., with no dropoff in concentration. It was then decided that the reaction was complete, and the acidizing operation was ended. The entire acidizing operation took 13 hours.

Acidizing was followed by the usual washing, neutralizing and passivating operations. During the washing operation considerable fine carbonlike material was washed out.

Results

Since all of the furnace coils in the heaters are made up with welded return bends at both ends of the tubes, there was no positive way of assuring ourselves that the job was 100 per cent effective. However, several temporary connections had been tied into the permanent piping to complete the acid-circulating circuit. Wherever these connections were removed, the inside of the lines was found to be completely free from scale.

The only residue found anywhere in the system was a very small amount of fine carbonlike material in the dead spot in the channel of the reaction-mix-feed heat exchanger.

Audigage checks of a number of the furnace tubes showed no evidence of internal scale. Furthermore when the unit was placed back in operation, the skin-point temperatures of the tubes were comparable with skin temperatures when the furnaces were first put in service.

These metal losses occurred on the various materials in the system during the acidizing operation:

Carbon steel, in.	0.002-0.003
1¼ per cent chrome moly, in.	0.002-0.003
5 per cent chrome ½ at moly, in.	0.003
11 to 13 per cent chrome, in.	as high as 0.150

Corrosion data taken at previous shutdowns were used to determine metal loss from corrosion during operation and, by difference, that from the acidizing operation.

Recommendations and Conclusions

In summarizing the experience obtained during this cleaning operation we feel that, with proper preparations and precautions, the job can be done safely and without undue hazard to personnel. We recommend the following in preparing for any similar acid-cleaning operation:

1. That extreme care be taken in assuring that a safe method of disposing of the H_2S is provided.
2. That a surge volume be provided in the system at least equal to the volume of the system to be circulated.
3. That the system be set up so that gage glasses do not have to be depended upon for control of the acidizing operation.
4. That careful control over the strength of the acid being pumped into the system be maintained at all times. Initial acid concentration in excess of 10 per cent should not be used.
5. That 12 per cent chrome-trimmed valves and equipment be removed from the circulating system wherever possible because of the ineffectiveness of present inhibitors in protecting this material.
6. That all personnel working in the cleaning area and in the surrounding units be advised of the operation that is taking place, of the potential hazards involved, and of the safety measures and equipment provided. **End.**

Special Pipeline Equipment Speeds Mill Inspection

FINAL inspection at a pipe mill requires the same kind of pipe handling that is desirable for operations at a double-jointing yard. During the past year Republic Steel Co. has installed at its Gadsden, Ala., mill a pipe-handling unit of a type that has been recently developed to expedite double jointing for pipeline construction. It is notable that a large pipe mill has come to the pipeline-construction equipment industry for such a unit.

The versatility, speed and easy flexibility of this unit has advantages over pipe-handling equipment regularly offered to pipe mills. Both initial and operating costs are less. The need for a crane is eliminated. There is none of the bridgework usually found at such mill operations.

The function performed by the unit is to rotate each joint of pipe so as to facilitate final inspection at the mill. Pipe reaches the unit at the end of all pipe-making operations, including those for double jointing 30-ft. joints to form 60-ft. joints.

While the unit rotates each joint at 5 to 6 r.p.m. the inspector can examine the weld and the surface of the pipe. From his station he has a clear view from end to end for detection of nicks, scratches, and gages. Any surface blemish makes pipe unacceptable. For the high-tensile pipe is so "notch sensitive" that long cracks or splits may be propagated by slight indentations. Rejection of such marred pipe in the field is naturally more expensive than culling at the mill before shipment.

In line with this modern policy of avoiding any marks on high tensile pipe, the pipeline industry now prohibits stenciling of field welds.

The pipe-handling unit is operated from a push-button station for controlling pipe movement—up and down, forward and backward, as well as in rotation. In addition to these three types of movement the unit provides for delivery of pipe to the right or left.

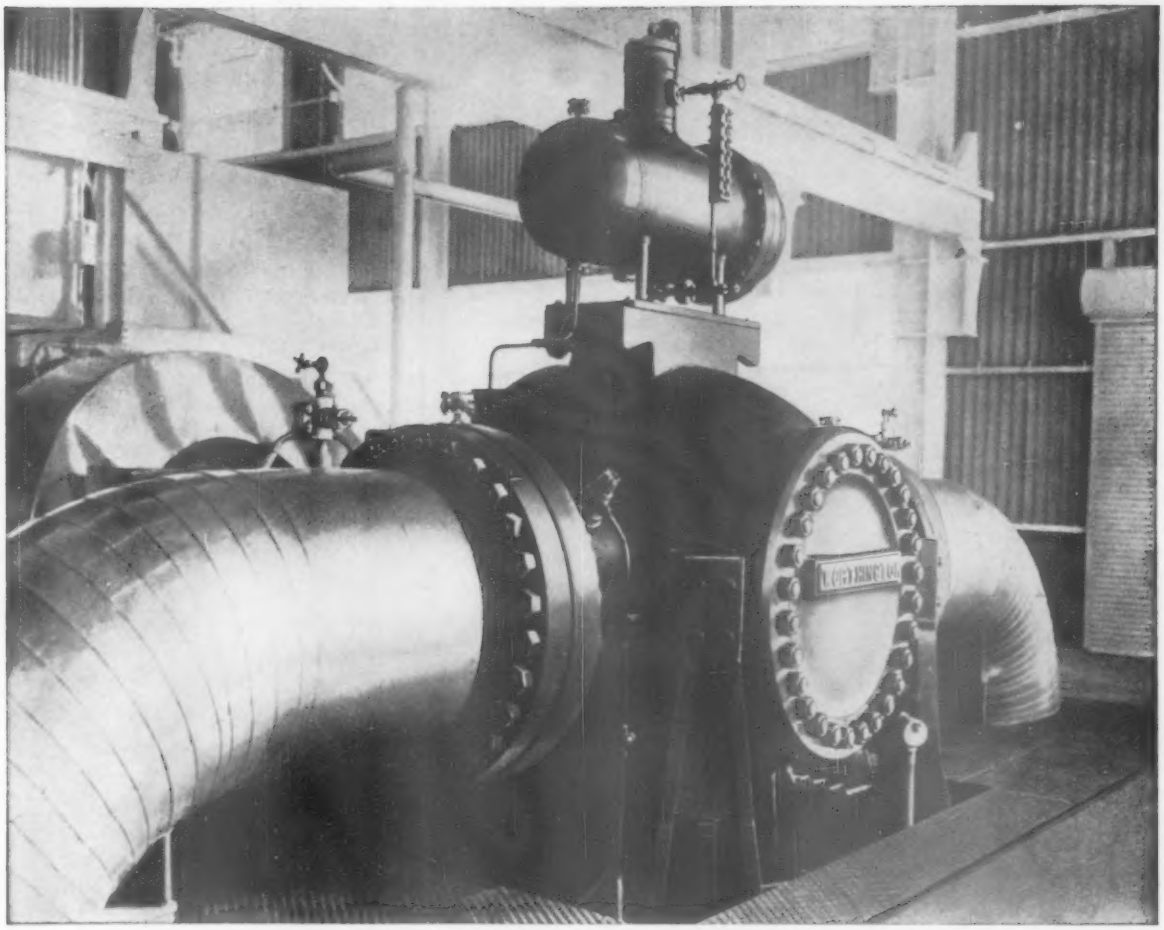
The 325-ft. endo roller conveyor eliminates need for a crane, ordinarily used for such pipe mill work. The two sets of vertical and horizontal conveyors do not interfere with each other. Furthermore, horizontal pipe movement is stopped automatically if it goes too far. Rotating rollers are 40 ft. apart. Rollers and vertical hoists are operated by electric-powered hydraulic units.

Pipe leaving the unit can be delivered to racks on either side, as desired by the inspector.

Advantages of this pipe handling unit have been demonstrated in the past year for two entirely different purposes—for double jointing in contractors' yards and for steel mill inspection. A third application also looks attractive.

This unit may be the first step toward automation in a pipe yard. The coming of automatic pipe storage yards is now being predicted as an inevitable development for handling pipe in and out of racks.

The Republic Steel unit was manufactured by M. J. Crose Manufacturing Co.



First "Center Line" Centrifugal Booster completes 18 months of pipeline service

Records show "practically no maintenance required"

This "new design" gas pipeline compressor has more than lived up to its advance billing. In service at Northern Natural Gas Company's Macksville, Kansas, station, since December, 1954, it has averaged 800 million cubic feet per day at a pressure of 500 psi. Records show that it has required practically no maintenance.

A brand new idea in compressor design, Worthington's type GUP compressor has a spherical casing supported at the center line. As a result, shaft distortions are minimized, starting stresses reduced, and bearing life extended.

A separate compressor driven pump supplies oil pressure at all times. By adding a cooler, the system may be made completely independent of the driver. A double trap in the scavenging system insures that no seal oil will seep into the gas stream.

It's easy to inspect. No internal part is too heavy for one man. The lightweight impeller, for example, weighs only 100 lbs.

If you'd like more information about this new pipeline compressor, write for bulletin C-1100-B57 to Section E66, Worthington Corporation, Harrison, N.J. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ontario.

E.6.6

WORTHINGTON

Now...load rate your bearings at higher values

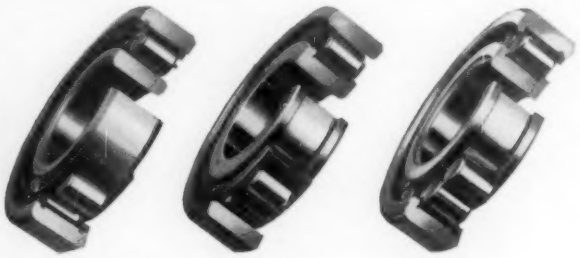
with Tru-Rol CROWNED ROLLERS

Greater capacity . . . longer life . . . or a precisely balanced gain of *both* factors. That is the choice offered you by the "crowned" rollers of Tru-Rol bearings.

By finish grinding a carefully selected crown radius on roller ends, Rollway relieves high stress areas, insures uniform distribution of load over the entire length of the roller. Rollers can take heavier loads without excessive end-fatigue, and are less subject to the effect of slight misalignment or deflection.

The result is load rating at higher values for greater capacity, longer service life . . . or both. If this choice interests you, why not write for the complete story. Rollway Bearing Co., Inc., Syracuse, N. Y.

Tru-Rol Bearings with crowned rollers are available in 3 types

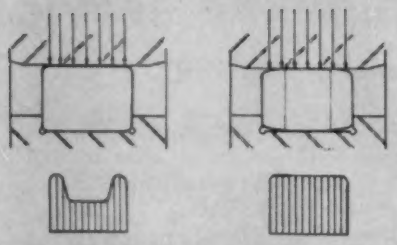


Stamped Steel Retainer with Guide Lips

Segmented Steel Retainer

Full Roller

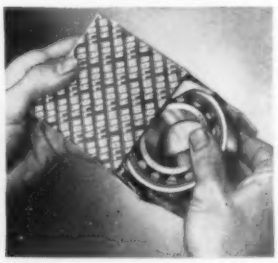
Comparative Stress Patterns under Uniform Loads for Straight and Crowned Cylindrical Rollers



Stress pattern for a straight cylindrical roller under load. Note uneven end-loading.

Stress pattern for crowned roller under load. Crowning radius is exaggerated for clarity.

● Rollway engineering service is available to help you select exactly the right bearings for your needs. Write us.



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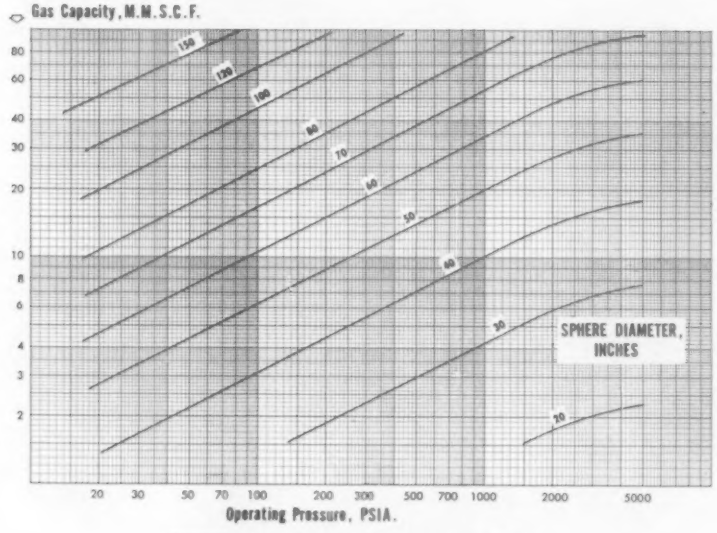
by Dave Vondy
Constructive Engineering Co.

SPHERICAL PROCESS VESSELS—7

Determining Spherical-Separator Capacity



SPHERICAL-SEPARATOR capacity. Fig. 5.

THE capacity of spherical separators as presented in Fig. 5 was determined from the theoretical analysis given below.

First it was recognized that in small spheres, allowance must be made for the reduced height above the inlet available for separation. A similar situation exists in fractionating columns where the smaller the tray spacing the lower the allowable capacity. The two cases are not identical because the jetting effect of gas rising from a contact plate is a distinct feature which must be considered in tower design. However, for want of better data, fractionation data will be used.

The common plot of the Brown-Souders constant vs. specific gravity with lines of constant tray spacing was used with the lines converged toward a specific gravity of 1.0 for a C value of 0.

Since separation in a sphere occurs with flow which is partially horizontal, the assumptions likely result in conservative results. A typical separation problem is that of separating condensate from natural gas.

Light material . . . An 0.65 sp. gr. gas was selected. An 0.65 sp. gr. liquid was selected which may seem low but is probably a good value considering that in most cases condensate under pressure contains much light material. Therefore it has a low specific gravity. Separation at 80° F. was considered.

Brown-Souders constants obtained for the 0.65 sp. gr. liquid are shown in Table 2. It was then assumed that 75 per cent of the cross-sectional area of a sphere is effective, giving an effective diameter, $D_e = 0.865D$, where D is actual diameter.

It was now assumed that one-fourth of the diameter of the sphere is available for disengagement. Taking into consideration the reduced value of C due to reduced height, a pseudodiameter, D_s, can be used:

$$D_s = D_e\,(C/700)^{1/2}$$

The density of gas can be obtained by the equation:

$$\rho_g = 2.71\ W_s\ P/TZ$$

and for 80° F. and 0.65 sp. gr. gas, the equation becomes:

$$\rho_g = 0.00326\ P/Z$$

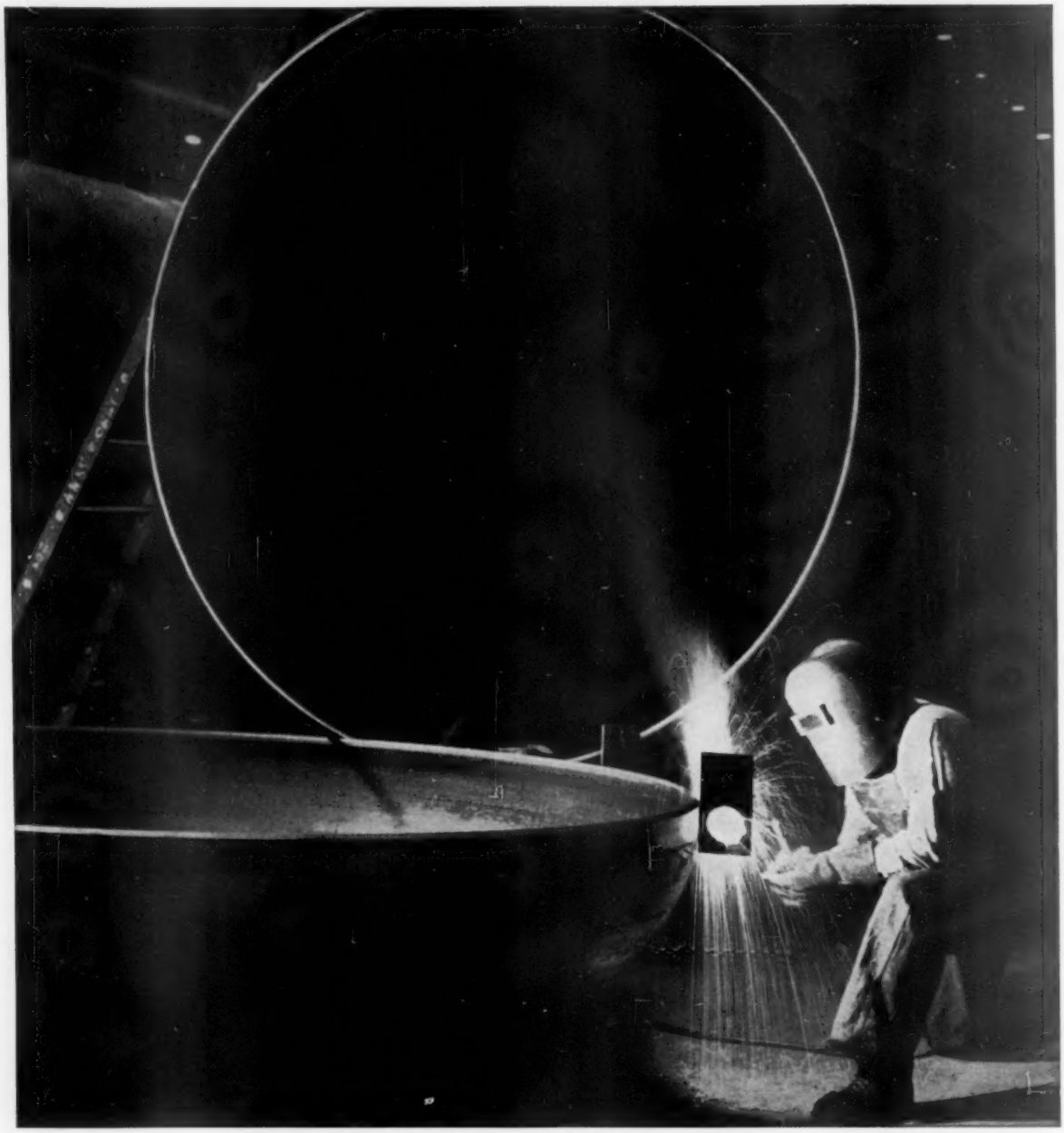
TABLE 2—PSEUDODIAMETER

D (in.)	C	D_e (in.)	D_s (in.)
20	140	17.3	7.7
30	205	26.0	14.0
40	275	34.6	21.6
50	350	43.2	30.4
60	410	52.0	39.8
70	480	60.6	50.2
80	545	69	60.8
90	595	78	71.7
100	630	87	82.4
110	655	95	91.6
120	675	104	102
130	685	112	110
140	700	121	121
150	700	130	130

CAPACITY

P (psia.)	Z assumed	ρ_g (lb./cu. ft.)	M (lb./hr./sq. ft.)	V (ft./sec.)	Q_s* (D = 70 in.)
14.7	1.0	0.048	980	5.67	6.67
50	1.0	0.163	1,800	3.07	11.5
100	0.99	0.33	2,550	2.14	16.7
200	0.98	0.67	3,610	1.50	23.6
300	0.97	1.01	4,370	1.20	28.6
500	0.93	1.75	5,770	0.92	38.1
750	0.90	2.71	7,080	0.72	46.4
1,000	0.87	3.75	8,220	0.61	54
1,500	0.82	5.96	10,000	0.47	66
2,000	0.79	8.25	11,400	0.38	75
3,000	0.80	12.2	13,000	0.30	86
4,000	0.85	15.3	13,700	0.25	90
5,000	0.90	18.1	14,100	0.22	95

*Million standard cubic feet per day.



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BETHLEHEM STEEL

ROCK-BIT DESIGN, SELECTION, AND EVALUATION

How to Interpret Excessive Tooth Wear

by H. G. Bentson
H. C. Smith Oil Tool Co.

EXCESSIVE tooth wear is shown by Fig. 33. Although the dullness of this bit is probably due to excessive rotating time, it is indicative of excessive tooth wear. High rotary speeds may be a cause of accelerated tooth wear in hard and abrasive formations.

The use of lower rotary speeds, when these formations are encountered, will increase tooth life and resultant bit footage. Use of an improper type of bit may also be responsible for excessive tooth wear. Since tooth wear is a function of the volume of tooth steel, the use of a harder formation type of bit having a greater number of teeth should reduce this wear.

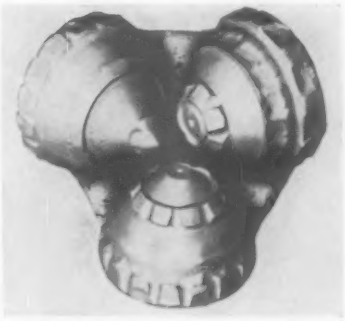
One additional cause may be due to the use of a non-hard-faced bit. Obviously if this is the case, a bit having hard faced teeth should be used.

... **Excessive cupping** or bluntness of the tooth crests is illustrated by Fig. 34. Teeth worn in this way will often yield decreased penetration rates and reduction in over-all performance. One possible cause of this type of wear may be attributed to the use of a double hard-faced bit in formations which do not contain sufficient abrasive materials to keep sharp teeth. The use of bit types with single face or single face and tipped hard facing should reduce this effect.

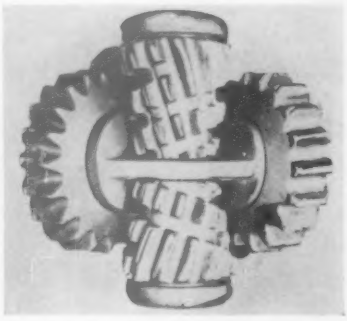
Another possible cause is the use of insufficient bit weight for adequate tooth penetration. Additional bit weight induces greater penetration by the teeth and results in an improved self-sharpening effect.

... **Bradding of the teeth** is illustrated by Fig. 35. Quite often this appearance is mistakenly interpreted as resulting from improper or inadequate heat treatment. However, this is generally caused by the use of excessive weight on a dull bit.

As the teeth become dull an increased amount of the softer core under the case-hardened surface is exposed to contact with the formation. Concurrently, bit weight is often increased in an attempt to maintain a desirable rate of penetration. If the compressive strength of the formation exceeds that of the core in the teeth, bradding will occur under the increased bit weight when the teeth become sufficiently dull. Similarly, a formation too hard for the bit type used will cause this bradding. Then the use of a harder formation bit should eliminate the problem.

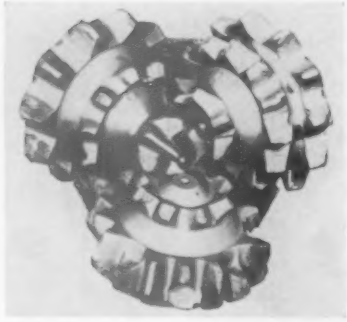


EXCESSIVE tooth wear. Fig. 33.



CUPPED teeth. Fig. 34.

BRADDED teeth. Fig. 35.



FLUID-CUT teeth and cone. Fig. 36.

... **Fluid-cut teeth** and cones are shown in Fig. 36. It should be evident from the condition of the inner rows of teeth that this fluid cutting can substantially reduce bit performance. Either an excessive circulation rate or an excessive amount of sand in the fluid can cause this type of cutting. Under these circumstances, a reduction in the rate of circulation or removal of the sand should stop this action.

An additional means by which this problem can be overcome would be the use of jet circulation bits. This method of circulation directs the fluid on the bottom of the hole instead of on the cones or cutters.

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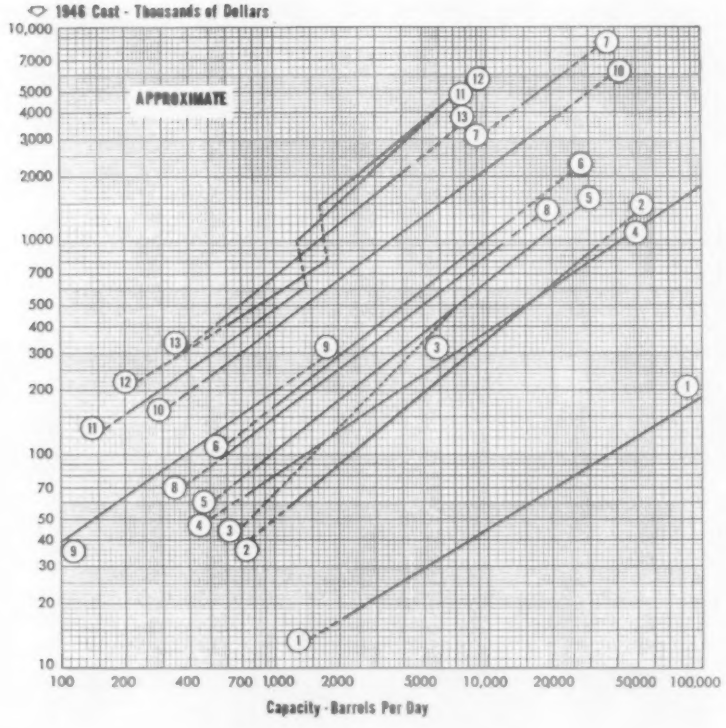
26. Over-All Plant Costs—

Distillation, Desulfurization, etc. (Approximate)

by W. L. Nelson
Technical Editor



NELSON REFINERY CONSTRUCTION COST INDEX*

	Material	Labor	M&L
1946	100	100	100.0
1947	122	113	117.0
1948	139	128	132.5
1949	144	137	139.7
1950	149	144	146.2
1951	164	152	157.2
1952	164	163	163.6
1953	172	174	173.5
1954	175	183	179.8
1955	176	190	184.2
1956 est.	192	198	195.6

*The Oil and Gas Journal, July 7, 1952, p. 105. The Index also appears in the first issue each month and in addition, indexes for many items of equipment are published in the first issues of the months of January, April, July, and October.

Curve	Operation—	Basis	No. of plants or references
1	Desalting crude oil	Bbl. per day feed	over 6
2	Vacuum flashing	Bbl. per day feed	over 18
3	Unifining (desulfurization)	Bbl. per day feed	over 7
4	Topping and other atmospheric distillation	Bbl. per day feed	over 45
5	Desulfurization (gasoline), catalytic	Bbl. per day feed	over 8
6	Desulfurization (gas oil), catalytic*	Bbl. per day feed	over 17
7	Desulfurization (residue), catalytic	Bbl. per day feed	only 1
8	Vacuum distillation (lubes)	Bbl. per day feed	over 20
9	L.P.G. recovery in refineries	Bbl. per day recovered	over 10
10	Solvent-extraction units†	Bbl. per day feed	over 22
11	Polymerization, catalytic‡	Bbl. per day product	over 32
12	Alkylation	Bbl. per day product	over 38
13	Solvent dewaxing units§	Bbl. per day feed	over 12

*With regeneration facilities, the cost is about 50 per cent larger. †Including propane deasphalting. ‡Apparently the large plants cost more because they are tailor-made for each job, or they may include feed concentration or extra operations. §Mainly MEK.

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Among the Drilling Contractors

Falcon Seaboard Coastal Rig Goes Year Without Accident

OPERATION for a full year without a reportable accident is a safety record recently set by crews on one of Falcon Seaboard Drilling Co.'s large rotary rigs on the Louisiana Gulf Coast.

During the year, the rig completed three deep wells and, at the close of the period, was on its fourth job. The three complete crews worked regularly the full period. Not one crewman, including the tool pusher, received so much as a scratch that could be reported. The safety-record time included such operations as rigging up, tearing down, and moving the rig.

Tool pusher on the rig is John St. Ores, who has been with Falcon Seaboard since 1937, and has had more than 35 years' experience in oil fields. He lives at Lafayette, La.

Drillers are Wayne Williams, LeRoy Semar, and Dave Leger. Williams has been with the company since 1942. He lives at Rayne, La. Leger, who lives at nearby Crowley, has been with the company since 1953. Semar broke out as driller for the company early in 1956.

Some of the crewmen, including Fred Hayden, Adam Kibodeaux, Ivy Semar, Ogden Meyers, Ralph Dupuis, J. J. Meche, and H. P. Simon, have been together more than 2 years, and have kept the rig's safety record intact that additional time.

THEY SET SAFETY RECORD—John St. Ores (right), tool pusher; and (left to right) Wayne Williams, LeRoy Semar, and Dave Leger, drillers of Falcon Seaboard Drilling Co.'s Louisiana Gulf Coast rig which operated a full year without reportable accident.

Herndon Drilling Co., Tulsa, has a rig running for Shell Oil Co. at a distant wildcat location 12 miles northeast of Lamar, in Prowers County, southeastern Colorado. The test, 1 Schmidt, in 27-21s-45w, is 25 miles from production. It is set up to go at least to 5,100 ft.

Power Rig Drilling Co., Lafayette, La., has contracted for a 10,500-ft. test to be drilled for Michel T. Halbouty, of Houston, at a wildcat location about a mile east of Reddell field, 6 miles southwest of Pine Prairie, in Evangeline Parish, South Louisiana. Location is on Halbouty's Marcena Fontenot lease, in 16-4s-1w.

Anschutz Drilling Co., Wichita, has a rig working for Continental Oil Co. at a wildcat location 10 miles northeast of Goodrich, in Wells County, in Central North Dakota. Location is for 1 Board of University & School Lands, in 16-147n-73w.

Mississippi River Fuel Corp. is getting under way on another deep well it has contracted to drill for Natural Gas & Oil Corp. in the East Golden Meadow area, 6 miles east of Golden Meadow, in the marshlands of coastal Lafourche Parish, Louisiana. The new operation, at 2 L. L. & E., in 43-19s-22e, is projected to 12,700 ft. Humble Oil & Refining Co. is a joint operator.

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Safer to use, operates in tight spots. For pushing or pulling. "Center-Hole" on rams over 30 tons. 10-100 tons capacities.

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Pyburn Drilling Co., Shreveport, is keeping a rig in the Killens Ferry area of Tensas Parish, northeastern Louisiana, where it is drilling for Robert R. Roberts. Latest contract is for 1-B Ayer, on the east side of the field. It will be a Tuscaloosa well, with pay about 7,000 ft.

Delta Offshore Drilling Co. has the contract for California Co.'s latest offshore wildcat venture, located in Block 107, Ship Shoal area, Gulf of Mexico, 25 miles off the coastline of Terrebonne Parish, Louisiana. Plans call for a 9,250-ft. test. Location is on State Lease 774 (OCS 070).

Burnham & Robinson Drilling Co., Shreveport, has a 5,600-ft. operation going on the northeast shore of Caddo Lake, about a mile north of Mooringsport field, in northern Caddo Parish, northwestern Louisiana. It is a contract job for E. D. Markham, of Oil City, and is projected as a Pettet test.

Gregg Oil Co., Gladewater, Tex., has contracted for two 5,000-ft. wildcat tests to be drilled in the Durant area, Holmes County, Central Mississippi. They will be for R. L. Price, of Tyler, Tex. One is at 1 McFarland, in 21-14n-4e, about 2 miles southwest of Durant. The other, at 1 Weems, in 1-14n-3e, is about 5 miles west of town. The area is about 20 miles north of Pickens field, nearest production.

Deckard Drilling Co., Shreveport, is an operating partner, as well as contractor, on a new 5,600-ft. Eutaw test 1¾ miles north of Heidelberg field, in Jasper County, eastern Mississippi. Location is at 1 Lightsey and others, in 27-2n-12e. Deckard's partners are Robert Womack and Earl Wilson.

Rhodes & Hicks, Alice, Tex., will drill a 4,800-ft. wildcat test 4 miles west of Charco, in northwestern Goliad County, South Texas. It is a contract job for Head & Welsh, of Houston. Location is listed as 1 Gladys Powell Key, in the Pedro Trevino Survey.

Nicklos Drilling Co., Houston, has the contract on another test C.A.T.C. group will drill in Block 43, Grand Isle area, in the Gulf of Mexico, 20 miles off the coast of Jefferson Parish, Louisiana. The test will be drilled from the same platform from which the group's discovery well, completed last October, was drilled, but will be deflected to a bottom location northeast in Block 69, West Delta area, off Plaquemines Parish. The discovery well is productive of gas and condensate from a 12,700-ft. sand. The new test is projected to 13,500 ft.

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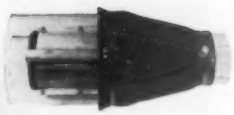

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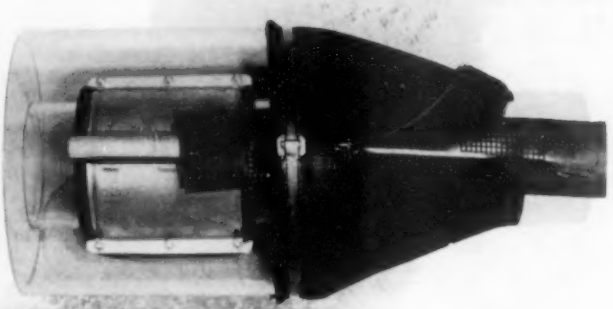

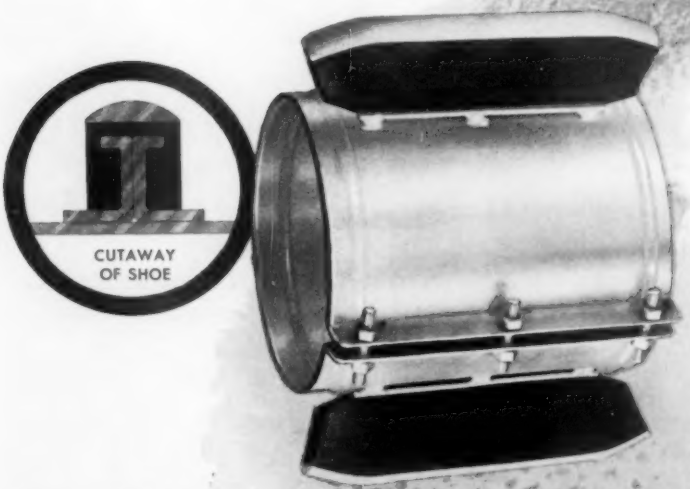

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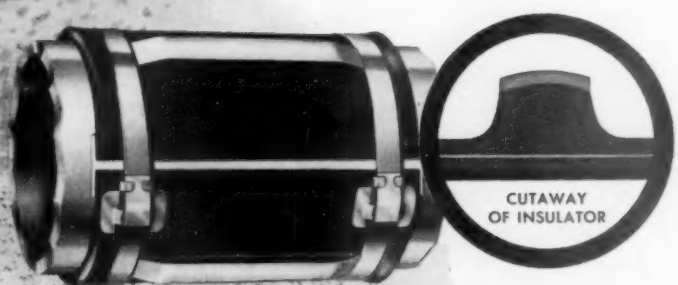
These insulators have superior insulation qualities because of the low moisture absorption and the long life compounded into the neoprene. The wide steel, sled type runners make installation easy. The extra wide band affords a positive grip. Bonded metal-to-neoprene-to-metal, the runner insulates and also permits flexibility to compensate for pipe shifting. Ribbed neoprene lining can be furnished if desired.

The Maloney Model 56 Casing Insulator

Manufactured in sizes from 2" through 12"

Manufactured with neoprene, which is vulcanized to the steel band core and to the rounded steel runners, there is no place to "short-out" between the casing and the carrier line. The steel core is completely surrounded with neoprene and is bonded under heat and pressure to give the same strength as on army tank tread blocks.



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2 Installing 22 and 18-in. valves for tapping through. Bypass connected the taps.

3 Cutting 22-in. segment of the line out at Goodfield station.

4 Here the tapping machine is shown in operation at Goodfield.

5 This is a new section of 22-in. pipe for the station and 18-in. bypass.

Sinclair avoids oil losses and down time when . . .

Booster stations are tied in 22-in. line

by E. I. Leabo

INCREASED throughput demand made it necessary for Sinclair Pipe Line Co. to add four booster stations to the 22-in. main crude line between Salisbury, Mo., and East Chicago, Ind., on the Cushing-Chicago system. This system, operated by Sinclair Pipe Line, is owned in undivided interests by Sinclair and Pure Transportation Co.

To avoid oil losses and down time with resultant loss in revenue, a tapping and stopple installation was selected for this project. While this method of tie-in was in progress, the pipeline continued to operate with normal pressures at the locations of the intermediate stations.

The general procedure used in the tie-ins was to make taps on the line to install a bypass around the station site. Two stopples (plugging devices) were inserted, one on either side of the station site and between the bypass connections. This blocked off the center section, which could then be replaced with prefabricated sections having gates and connections for the new station. After this was done, the main line was reopened, the bypass removed, and the line placed back in normal operation.

Booster stations . . . The booster stations tied in by this procedure are located at Kankakee, Goodfield, and Rushville, Ill., and Shelbina, Mo.

Without the use of the line-plugging device, a lengthy shutdown could not have been avoided. Many miles of the line would have had to be drained from the nearest upstream block valve to the station site or a higher point downstream. Since it was not considered feasible to attempt four tie-ins during a single shutdown, the line would have been out of service four times. And even with closer planning and good fortune in completing the work, down time would have amounted to many days.

How it was done . . . Since the tie-in procedure at all stations was the same, a description of one will suffice.

First, 22 by 22 by 18-in. split tees with 18-in. 600-lb. A.S.A. special flanges were welded on the line upstream and downstream from the points where the line would be blocked. An

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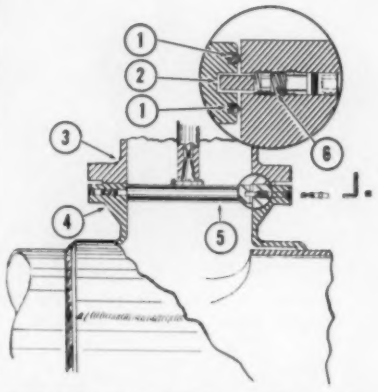
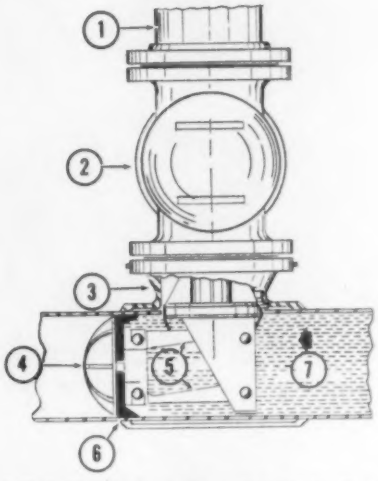
PIPELINE PATROL



DETAILS OF FLANGE and blinding plug which seals tapped opening after stopple has been withdrawn. 1—O-ring seal, 2—locking-ring segment, 3—gate-valve flange, 4—flange, 5—plug, 6—locking-ring screw.



DETAILS of the sealing element in final position. 1—stopple housing and flange, 2—tapping valve, 3—side outlet welded to pipeline, 4—stopple nose, 5—parallelogram linkage, 6—neoprene sealing element, 7—line pressure.

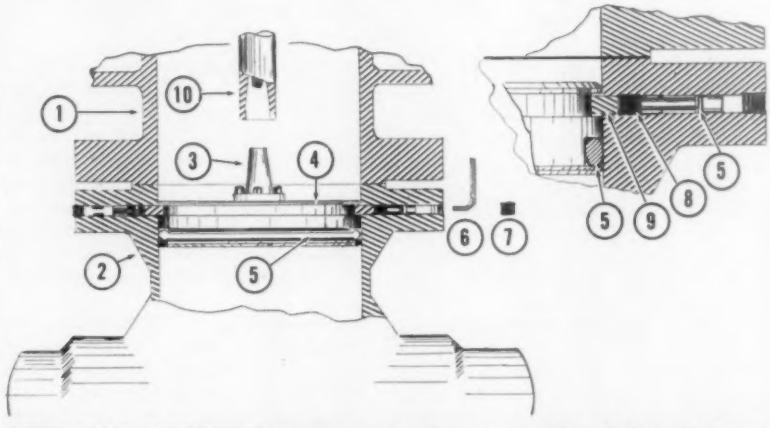
18-in. gate valve was installed on each fitting and a tap made in the line. Some 600 ft. of 18-in. bypass line was laid to connect the two taps.

Next, 22-in. split-tee fittings with special flanges were welded on the main line between and next to the bypass connection. These were for installation of the stopples.

The special flange used is designed for later installation of a plug to seal the tapped outlet. The inside circumference of the flange has a machined groove which contains four steel segments attached to and moved by bolts operated from outside the flange. This plug is installed in the flange at the end of the line-plugging operation, and the segments are locked into place within a matching groove on the periphery of the plug.

The segments afford the necessary mechanical strength to hold the plug in place against operating pressure. Complete sealing is effected by O-rings on the plug circumference.

Then 22-in. gate valves were installed at both locations, and a big-inch tapping machine was used to cut a 21¼-in. diameter hole within the 22-in. split tee and against the full pressure of the oil flow. The bypass was then opened, the stopples were mounted on the 22-in. gate valves, and the main line was blocked by running the sealing elements into position. The actual seal was made



AFTER PLUG IS LOWERED into flange, ring segments are advanced into plug groove securely anchoring plug. 1—tapping valve, 2—flange, 3—removable plug holder, 4—plug, 5—neoprene O-ring, 6—Allen wrench, 7—pipe plug, 8—retainer-ring screw, 9—retainer-ring segment, 10—boring bar of tapping machine is retracted after releasing plug holder.

It takes a Sea Going Rig for this kind of a job!

THE MUSKRAT LINE, Tennessee Gas Transmission Company's Louisiana Coastal line, taxed the ingenuity of both man and machine.

Here is the lay barge used by Houston Contracting Co., the work horse of the operation. The big Northwest Model 95 is setting an offset joint to the valve platform.

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Northwest versatility—its ability to go places and do things a little more smoothly, a little faster, make it a cost cutter and time saver whether it's afloat on a barge or handling pipe in the desert. Steering with positive traction on both crawlers while turning as well as when going straight ahead takes it where other similar machines have difficulty.

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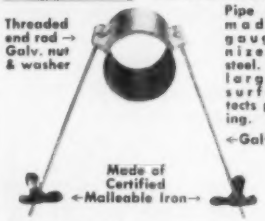
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PIPELINE PATROL

THE AUTHOR

E. I. Leabo, senior mechanical engineer for Sinclair Pipe Line Co., has been in the design and construction section of Sinclair companies since 1940; from 1940 to 1941 and from 1942 to 1951 with the gasoline department of Sinclair Oil & Gas Co.; from 1941 to 1942 and from 1951 to the present with Sinclair Pipe Line Co. He is presently in charge of design for additions to the Sinclair Pipe Line systems.

by fluid pressure on the sealing element's flexible neoprene lip.

A hydraulic motor was used to rotate the stopple shaft in extending the sealing element through the valve and into the pipeline. Final positioning of the sealing element required the use of a hand-operated ratchet lever.

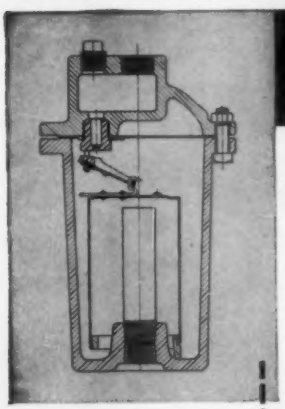
Little oil lost . . . When plugging was completed, a 4-in. tap in the section between line plugs was used to insert a suction line to pump out the oil trapped in that section. In the entire operation, the only loss was that which could not be picked up from the removed section and that within the machine housing—a couple of barrels at each location.

After testing of seals and removal of oil, the dead section was cut loose with mechanical pipe cutters and removed. Two prefabricated reverse-bend sections, one containing the station-suction gate and the other having a gate and connections for the station discharge line, were then installed to replace the cutout section. The tie-ins were made by use of weld-end couplings.

Connections were made to the station suction and discharge lines, and the newly installed section was filled with oil as the air was exhausted.

Taps resealed . . . At this point, the sealing elements were backed out of the line, the 22-in. gate valves were closed, and the stopples were removed. The plug was then installed on the tapping machine and the machine was mounted on the valve. When the valve was opened, the plug was lowered into the special flange. After the sealing plug was anchored the tapping machine and the 22-in. gate were removed, and a blind flange was bolted in place over the assembly.

The bypass valves were closed and the bypass line was pumped out and disconnected, leaving the newly installed section carrying the full line load and ready for the booster station to begin operation. **End.**



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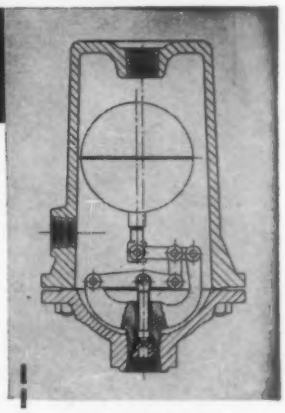

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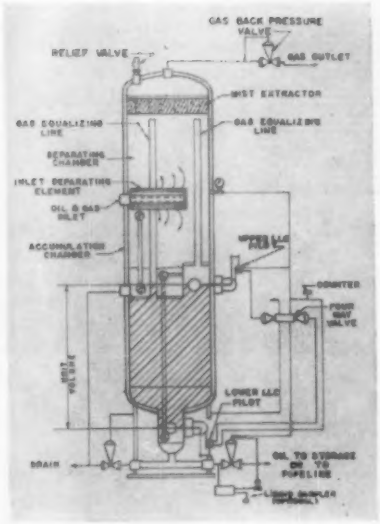


Metering Separator Uses Two Control Pilots

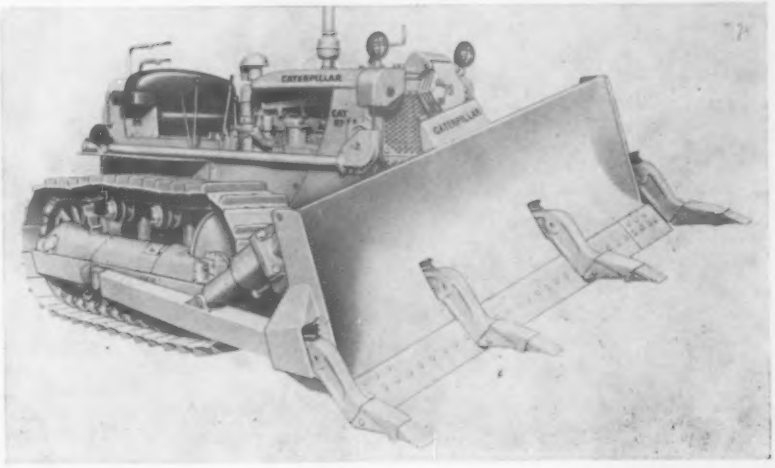
This new Type F metering separator provides an economical and accurate method of separating and metering well-fluid components, the maker states. And it requires little maintenance.

To achieve high accuracy, two liquid-level-control pilots are employed—one at the upper dumping level and one at the lower dumping level. When the separator operates, well fluid enters the upper compartment or separating chamber and passes through a degassing element. The gas then moves through a mist extractor and discharges from the top of the separator.

When the liquid reaches the low-level control point, the discharge valve closes and the inlet valve opens. This completes the cycle and one dump is recorded on a counter or recorder.

The separator is designed for such uses as metering oil for royalty and tax payment, testing wells, segregating produced oil, and for automatic lease operation.

It is available in working pressures of 125 to 2,400 psi., with dump volumes ranging from ¼ to 10 bbl. Metering capacities varying from 300 to 4,000 bbl. per day. And either pneumatic or electric controls are available. **Write or call: Oil Metering & Processing Equipment Corp., 4843 Yale Street, Houston 18, Tex., for details on Type F metering separator.**



Bulldozer Cuts, Rips, and Moves

A new concept in bulldozer design is incorporated in this Caterpillar Gyro Dozer, the maker reports. The new earth-moving tool combines the functions of ripping and moving material in one bulldozing operation. Thus it eliminates the need for a separate ripping operation. Working in hard-to-handle material, it produces full bladeloads quickly and in short distances.

The bulldozer provides a high dozing efficiency by restricting **the length** of cutting edge entering the ground, by breaking up and conditioning hard material readily, and by supplying an efficient wedging angle to utilize the full power of the tractor.

The key factors aiding the high production of the Gyro Dozer are its four penetrating teeth mounted on the cutting edge of the bulldozer blade. Extending forward 20 in. in front of the cutting

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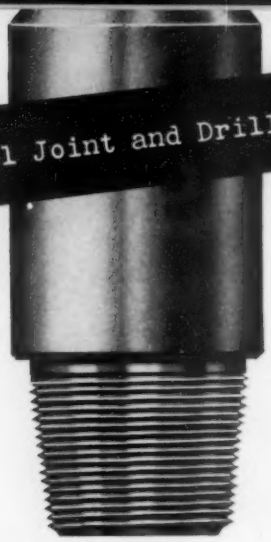

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New Equipment

edge, the teeth are used in ripping up stubborn material in order to rapidly obtain full loading of the blade.

To aid in facilitating any desirable ripping angle of the teeth, the blade is capable of being tipped both forward and backward and of being tilted 20° to either side. The tilting action is provided by two hydraulic cylinders mounted on the blade in place of tilt braces.

The blade is controlled by a front-mounted hydraulic control. Full positioning of the blade can be accomplished during operation by two levers to the right of the operator. **Write or call: Caterpillar Tractor Co., Peoria, Ill., for details on Gyro Dozer.**

●

Nitrogen Generator Gives In-Plant Nitrogen Source

Oxygen-free nitrogen can be produced from ammonia in the plant with this new Nitroneal nitrogen generator at a cost many times less than that of nitrogen purchased in cylinders.

Providing a wide controlled-hydrogen-content range, the Model GNLX generator draws nitrogen from both air and ammonia, rather than from ammonia alone. Because the reaction is exothermic, no external heat is necessary, eliminating the expense of replacing burned-out heating elements periodically.

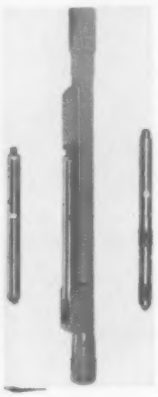
Fully automatic, the generator requires no maintenance and can be operated by an unskilled worker attending the apparatus only ½ hour per day, the maker states.

The GNLX is equipped with a removable insulator which protects one of two catalyst chambers when a high hydrogen content is required. Thus it can produce nitrogen with any hydrogen content between 0.25 and 25 per cent, without overheating the catalyst.

Ranging in size from 50 to 10,000 standard cubic feet per hour, the machine is shipped as a single unit, completely portable. The only connections required are a 110-volt electrical receptacle, a drain, and single lines for water, air, and ammonia. **Write or call: Instruments Div., Baker & Co., Inc., 207 Grant Ave., East Newark, N. J., for Nitroneal nitrogen generator brochure.**

●

Gas-Lift Valve Features Strong Bellows



To prevent deformation from excessive pressure differential, this new McMurry Type M gas-lift valve employs a bellows assembly in which support rings have been placed at each bending point. The bellows is then pressurre formed around the support rings so the bellows supports itself when subjected to excessive pressure differentials. Thus, the support rings will not allow the bellows to collapse. And the spring of the bellows is maintained to a high degree, regardless of well conditions.

Further, the valve is equipped with a double-ball gravity-acting check to prevent backwash. The lug is designed so little pressure drop will occur between the inside diameter of the lug and the inside diameter of the tubing. This design is used to prevent impingement of high-velocity gas and sand-laden liquids against the opposite side of the inside of the mandrel and thus lengthen mandrel life.

The gas-lift valve, reverse check, and mandrel can be stripped completely in a few minutes for field servicing. And

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THERE'S A REASON . . .

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the bellows can be examined under pressure.

Too, the valve has a large pressure dome so pressure buildup within the valve will be held low during the opening of the valve. The valve is adaptable to either constant or intermittent flow. **Write or call: McMurry Oil Tool Specialties, Inc., 1020 Houston Avenue, Houston, Tex., for details on Type M gas-lift valve.**

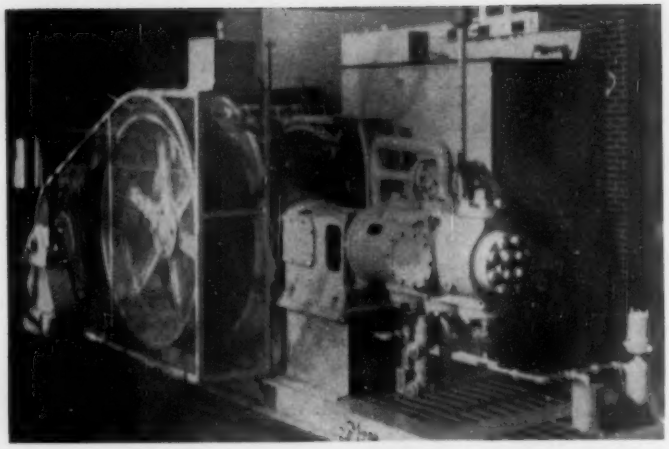
●

Thread-Sealing Compound Dries Slow, Sets Soft

A feature of this new thread sealing compound, Rectorseal 5, is that it dries slow and sets soft and doesn't dry in the open can. And under recommended service conditions, it will not harden with age, the maker states.

The plastic elasticity of the compound allows joints to be broken easily at any time without damage to the threads. The preparation contains no lead or other metals. And extended field tests show it is suitable for piping connections carrying air, natural gas, manufactured gas, nitrogen, helium, steam, propane, butane, sulfur dioxide, all freons, anhydrous ammonia, and water.

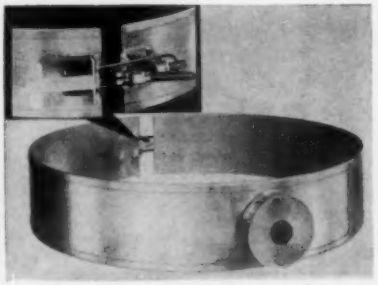
The compound is available in ¼, ½, and 1-pt. brush-top cans and 1-qt. friction-top cans. **Write or call: Rectorseal Div., Rector Well Equipment Co., 2215 Commerce Street, Houston 2, Tex., for details on Rectorseal No. 5.**



Packaged Compressor Allows Easy Service

By incorporating the horizontal separator and most of the piping within the base of this new packaged gas compressor, the manufacturer has allowed a large working area for the service man.

The available engines range from 50 to 600 hp. maximum. And the compressors have either a 9, 11, or 13-in. stroke. **Write or call: Southern Engine & Pump Co., 2401 McKinney Street, P. O. Box 1697, Houston 3, Tex.**



Heater Makes Materials Easier to Pour

Improved conduction for heating standard 55-gal. steel drums is provided by this new RH-1 Acrawatt drum heater, the maker states. It is designed to heat 22¼-in. diameter drums containing such materials as plastic resins, oils, adhesives, and nonvolatile chemicals which require heating to facilitate their removal from the container. The heater's features include: (1) a quick-action toggle clamp, (2) built-in three-heat switch, and (3) wiring circuits providing uniform heating at any of three settings.

At the high setting of 230 volts input, each heater delivers 3,000 watts or 10,236 B.t.u.'s according to the manufacturer. At the medium setting, their output is 50 per cent of the maximum, and at the low setting, it is 25 per cent of maximum.

The heater can be applied to and removed from containers by merely releasing the lever of the spring-loaded toggle clamp and permitting the element to slide on or off. The clamping device can be separated from the bracket slots to increase the heater's size or permit moving it over protrusions. And the clamping pressure can be adjusted to suit individual drums.

The drum heater is 5 in. wide, with a sheath or metal enclosure of aluminized steel. The heat-generating resistors

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

.....

.....

Described in OIL AND GAS JOURNAL - Issue of **March 11, 1957**

NAME.....TITLE.....

COMPANY.....

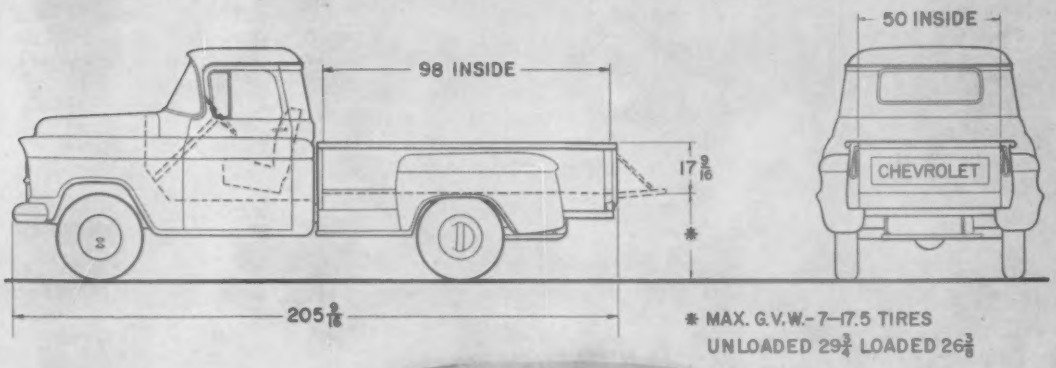
ADDRESS.....

CITY.....STATE.....

DATE.....

Pick a practical pickup!

Check the size of a 1957 Chevy Pickup body for evidence of practical design. The box of the new long-wheelbase ½-ton Pickup is a full 98" long—currently the longest ½-ton Pickup body size you can get!



This big built-for-work "box" makes CHEVY first choice in Pickups!

These best selling '57 Chevrolet Pick-ups are practical trucks in every respect. They offer modern power to keep your costs down low, modern looks to keep your prestige up high... and all these modern body advantages to help you make light work of tough jobs!

They're the most practical and profitable Pickups going! For example, they enable you to load more easily and quickly, thanks to *low* loading height and steel skid strips in the long-lasting hardwood floor. And for your bulkiest loads, stake pockets accommodate the addition of racks or side boards. Other modern advantages include extra hauling space provided by *outboard wheel housings* . . . a grain-tight tailgate with anti-rattle latch that strengthens the sides . . . and practical level-ledge side panels. Chevy gives you running boards, too, for convenient side loading. These new Pickups come in a wide range of ½-, ¾- and 1-ton models with spacious boxes ranging up to more than 9 feet in length. See your Chevrolet dealer for the one that suits your job. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

'57 CHEVROLET TASK·FORCE TRUCKS

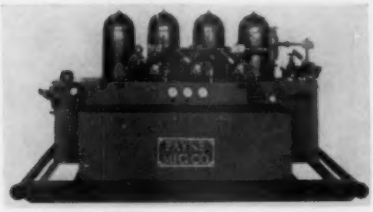
PROVED ON THE ALCAN HIGHWAY . . . CHAMPS OF EVERY WEIGHT CLASS

CHEVROLET

SHOWCASE . . .

New Equipment

are nickel-chromium, insulated with sheet mica. The heater is available in two capacities—3,000 watts at 230 volts, and 2,500 watts at 115 volts. **Write or call: Acra Electric Corp., 9909 Pacific Avenue, Franklin Park, Ill., for more information on RH-1 drum heater.**



Accumulator Unit Needs No Bladders

All-steel construction and a service pressure of 2,000 psi. are features of this new Payne nonseparator type of accumulator unit. Made in a 20-gal. size, the accumulator has no rubber bladders, diaphragms, or piston packing.

It comprises only three parts, and each part is easily and quickly replaceable in the field.

The accumulator unit may be obtained in multiples of one to six for use with Payne blowout-preventer operating units, depending on the quantity of fluid needed. **Write or call: Payne Mfg. Co., P. O. Box 9278, Houston, Tex., for details on nonseparator type of accumulator unit.**

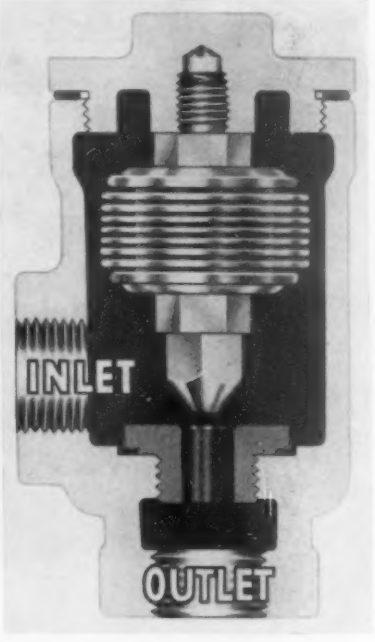
competition *makes it better!*

Let's face it. It isn't the size that makes the music sweet. Competition keeps the new tunes coming. Competition makes oil well cementing better, too. On your next cementing job, call the company that *put* competition in the business and *keeps it there.*

Engineered answers to oil well cementing

BJ SERVICE, INC.

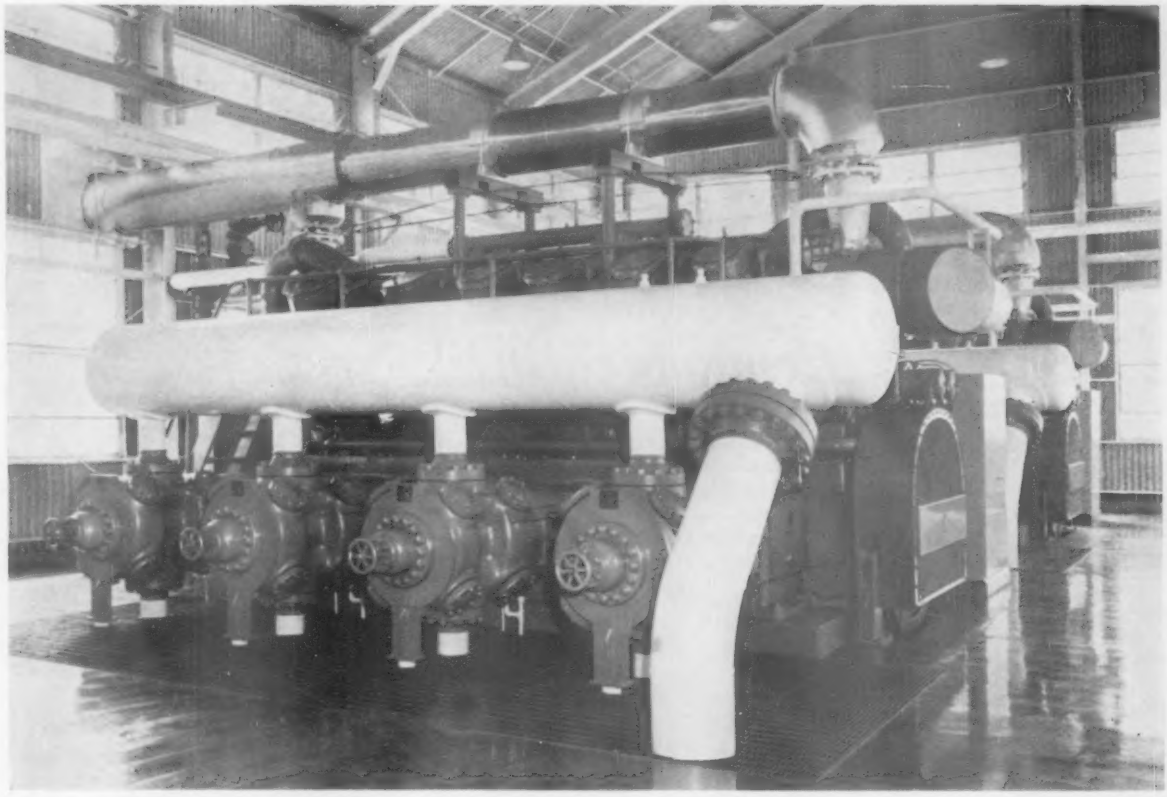
For Details, See Page 215



Steam Trap Operates on Temperature Differential

Where frequent shutdowns and start-ups, elimination of large amounts of air, or maximum protection against freezeup is required, this new Clark thermostatic steam trap offers a solution. Designated the Series A, the trap operates on a temperature-differential principle, as contrasted to buoyancy. Of cast semisteel construction, the trap is available with bronze or monel bellows and vertical outlet.

It's fitted with an orifice that operates over the pressure range 0 psig. to maximum rated pressure. The trap is made for steam pressures up to 250 psi. and temperatures to 450° F. The inlet and outlet connections are ½ and ¾ in. Either angle or straight-through piping is optional. **Write or call: Clark Mfg. Co., 1830 East Thirty-eight Street, Cleveland 14, Ohio, for details on Series A stream trap.**



At Shelbyville, Indiana

American Louisiana installs 10,000 hp of KVS turbocharged gas-engine compressors

At Shelbyville, Indiana, in one of the three primary stations of American Louisiana Pipe Line Company, the efficiency of Ingersoll-Rand compressors and the flexibility of 4-cycle power are being applied to the task of supplying gas to utilities in Michigan, Wisconsin, Iowa and Missouri.

All of the five gas compressors at the Shelbyville station are 2000-hp Ingersoll-Rand KVS turbocharged gas-engine units. These are basically the same machines which have been setting new records since the first KVS was installed early in 1952, but incorporating the improvements which have resulted from years of tough service.

Incidentally, the first KVS (and the world's first turbocharged engine-compressor) was installed for an American Louisiana affiliate. With the forthcoming installation of six units at its new Defiance (Ohio) station, American Louisiana and affiliates will be operating 23 KVS compressors totalling 44,000 hp.

In addition to heavy-duty compressors, Ingersoll-Rand equipment for pipeline services includes rugged 4-cycle V-angle engine-generating units, centrifugal pumps, starting-air compressors, air and electric Impactools, and many other products. Ask your I-R representative how I-R can help you on your job.

Only Ingersoll-Rand Compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of rigid stainless-steel channels and leaf springs, with trapped-air spaces which cushion action.

Ingersoll-Rand 4-CYCLE

6-501

11 BROADWAY, NEW YORK 4, N.Y.

COMPRESSORS • GAS AND DIESEL ENGINES • ROCK DRILLS • PUMPS • TURBO-BLOWERS • AIR AND ELECTRIC TOOLS

NOW you can enter against pressure for Corrosion Control

Safely...Economically!

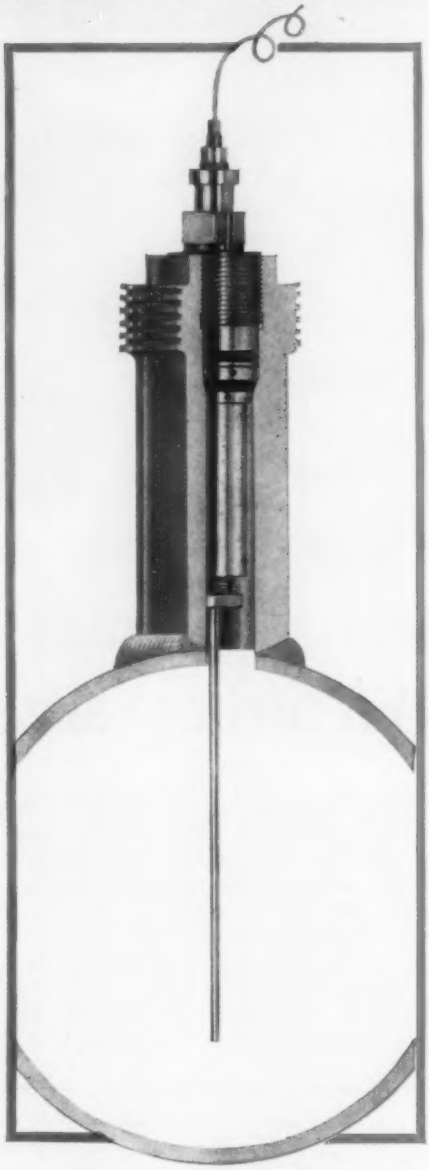
Without interfering with operations, you can now go into vessels and pipe lines on stream to investigate corrosion, its rate, cause and effects. This is possible when COSASCO *Access* Nipples are installed at strategic locations as pressure-proof ports for the insertion of coupons and to secure data with water samplers, thermocouples and hydrogen probes.

While coupons continuously provide means of recording rate of corrosion, samplers permit periodic analysis of possible causes, thermocouples contribute desired temperature readings and the hydrogen probe helps to determine the concentration of free hydrogen present. With such information at hand, intelligent application of measures for control can be made to prolong equipment service life, reduce or eliminate product pollution and, consequently, protect important capital investment. In many cases, product quality can be more easily maintained.

COSASCO *Access* Nipples may be installed at any time: either during shutdown or, with a COSASCO Hot Tapping Assembly, while vessel or line is under full operating pressure.

The *Access* Nipples have removable low-carbon type 303-304 stainless steel plugs. Special plugs for the samplers, thermocouples, and hydrogen probes are also of this highly corrosion-resistant material. COSASCO *Access* Nipples are applicable to any pressure or storage system, hydraulic or gaseous.

COSASCO



THERMOCOUPLE ACCESS PLUG

Here a Thermocouple Plug is shown in place in an *Access* Nipple welded to a tapped pipe line. The closed-end tube extending into the line contains the iron-constantine wire inserted through the plug. The entire assembly is completely pressure-proof. Plugs fitted for water sampling and probing for hydrogen are basically similar. Details will be supplied on request.

What's your problem?

If it's an entry-against-pressure problem, COSASCO engineers invite you to submit details. Send blueprints or drawings to depict the problem, and the COSASCO solution will be supplied *without charge*. You will be under no obligation whatever for this service.

Protect equipment . . . Save product

COSASCO

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Address Mail to P.O. Box 277, La Canada, California • Export Office: 617 S. Olive Street, Los Angeles 14, California

SHOWCASE . . .

New Literature

Industrial Tractors and Equipment. This new comprehensive 32-page booklet presents the features and applications of John Deere track and wheel type of tractors, their specifications, and design details. Too, it describes the various equipment available for use with the tractors, including a crawler loader and an angling dozer. The booklet is well illustrated with photographs showing the tractors' features and advantages. **Write or call: Industrial Div., John Deere, Moline, Ill., for booklet on industrial tractors and equipment.**

●

Automatic Emergency Lighting Units Catalog 11-1957 describes emergency power systems for lighting, fire alarms, and public-address systems. The units' charging equipment is completely automatic, contains no manually operated switches or timers, and keeps the battery correctly charged, the four-page catalog points out. The battery for the lighting units is a 6-volt type with a 105 amp.-hr. capacity, sufficient for 12 hours of light. The unit will support up to five heads. These can be remotely mounted as desired. **Write or call: Electric Cord Co., 21 Spruce Street, New York 38, N. Y., for Catalog 11-1957.**

●

Bottom-Hole Regulators. This new two-page data sheet tells what Otis bottom-hole regulators are and what they will do. According to the data sheet, the regulators eliminate surface heaters altogether by reducing the well pressure at a point deep in the tubing string where the subsurface temperature is high. Thus the tubing serves as a long subsurface heater to reheat the gas after expansion. **Write or call: Otis Pressure Control, Inc., 6612 Denton Drive, Dallas, Tex., for data sheet on bottom-hole regulators.**

●

A Survey of Water Conditioning Practices. This new bulletin contains brief discussions of advances in methods employed in conditioning water by external and internal treating processes to permit maximum reuse of water within economical limits. **Write or call: D. W. Haering & Co., Inc. Box 6037, San Antonio, Tex., for bulletin, A Survey of Water Conditioning Practices.**

●

Blowout Preventer Operating Units. This new 20-page photographically illustrated catalog, the tenth edition, covers the complete line of Payne blowout-preventer operating units, accumulator units, control equipment, and general service and high-pressure plain-end plunger pumps. It furnishes installation, maintenance, and operation data along with complete parts and price lists. **Write or call: Payne Mfg. Co., P. O. Box 9278, Houston, Tex., for general catalog.**

●

Bronze and Steel Valve Catalog. This 80-page catalog on Hancock bronze and steel valves covers globe, angle, gate, and other types of valves applicable to petroleum and petrochemical installations. The catalog includes material specifications, flow charts, and temperature and pressurue ratings. **Write or call: Manning, Maxwell & Moore, Inc., Stratford, Conn., for bronze and steel-valve catalog.**

●

Selection and Specification of Wire Rope, care in its handling and installation, abuses to avoid, and preventative maintenance are all clearly explained in this series of seven bulletins, titled Rope Dope Educational Bulletins, Vol. 5. In the new bulletins, the accumulation of recommended practices presented over the past 15 years have been reorganized and are carried in a more normal sequence through the seven bulletins. Much new information has been

WHITMOR homes satisfy both employee and employer . . .

You win every time with WHITMOR! Whitmor builds highest quality, site fabricated field homes that have won the approval of over 1,000 satisfied customers across the nation. Be sure to select Whitmor homes for your next housing project. You will get more for your money and your employees will appreciate the distinctive home design with interiors planned for maximum comfort and livability. Whitmor's "lease-rental" program offers you many economic advantages —ask us about it!

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INDUSTRIAL HOUSING | THE FINEST IN THE FIELD

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Salt water disposal lines of USS NATIONAL* POLYVINYL CHLORIDE PIPE

provide quick installation, permanent corrosion resistance

W. C. McBride, Incorporated of Oiltown, Oklahoma, is using two 4-inch diameter lines of High-Impact NATIONAL PVC Pipe to join two crude oil separator tanks with a new salt water disposal well. The two PVC lines—one 1,400 feet long and the other 600 feet—run from the separator tanks to a 250-barrel salt water collecting tank which acts as a siphon for the well. A 20-foot section of PVC Pipe then joins the collecting tank to the well.

The complete PVC Pipe installation was made in a few hours. Joining was accomplished by solvent cementing, and in some cases, threading. The three-man crew that installed the pipe found it extremely easy to install.

Here are some advantages of NATIONAL *PVC Pipe that make it particularly suitable for applications like this:*

It possesses high chemical resistance to acids, alkalis, salt solutions, alcohols and many other chemicals. It is rigid and lightweight . . . can be joined by threading (Schedules 80 and 120), by solvent cementing, heat welding, or with adhesives. And NATIONAL PVC Pipe is marked every two feet with size, schedule, recommended maximum pressure and temperature.

Nontoxic, NATIONAL PVC Pipe resists deterioration from sunlight, fungi, bacterial action and soils. Its smooth internal surface offers low flow resistance.

NATIONAL Polyvinyl Chloride Pipe comes in sizes ½″ to 6″ inclusive, and in Schedules 40, 80 and 120. Two types are available:

NORMAL-IMPACT—for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

HIGH-IMPACT—for installations requiring excellent chemical resistance and a high degree of toughness even at low temperatures.

For complete information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Specify Bulletin No. 24.

*Trademark

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL **PVC** PIPE

This seal of the National Sanitation Foundation is carried on all National Tube Polyvinyl Chloride Pipe and means—Tested . . . Approved . . . Sanitary!

NSF

UNITED STATES STEEL

added. **Write or call: Union Wire Rope Corp., Twenty-first and Manchester Avenue, Kansas City 26, Mo., for Vol. 5 of Rope Dope Educational Bulletins.**

●

Valves and Fittings for the Petroleum Industry are the subject of comprehensive 174-page Catalog 101 P. Devoted to the products of Newman, Hender & Co. of Woodchester, England, the catalog furnishes complete specifications on the company's valves, christmas-tree assemblies, crosses, chokes, flanges, and fittings. The screwed-end valves and fittings are available with either A.P.I. line pipe or B.S.T.P. threads. Flanged valves, cocks, and fittings are supplied with flanges to either American or British standard dimensions. **Write or call: Newman, Hender & Co., Ltd., Woodchester, Stroud Glos., England, for Catalog 101 P.**

●

Air-Motor Grinders and Drills Bulletin 61 (four pages) detailing the features and applications of Airetool products furnishes the specifications on both horizontal and right-angle grinders and on air-motor drills. The grinder's applications include metal removal, sanding, or buffing operations on castings, forgings, welds, or other metal construction, on either flat or curved surfaces. The drills' applications include any drilling or reaming operations where portability is a factor. **Write or call: Airetool Mfg. Co., 595 Broad Street, Columbus 15, Ohio, for Bulletin 61.**

●

Shale Ban Mud, a chemically treated mud for reducing dispersion and hydration of clays and shale cuttings and for hardening shale formations exposed in the bore hole, is the subject of this new four-page product-data sheet. The data sheet explains what Shale Ban mud is and how it reduces the buildup of drilled solids in the mud. Further, it explains how the mud is prepared and maintained. **Write or call: Baroid Div., National Lead Co., Box 1675, Houston 1, Tex., for Shale Ban data sheet.**

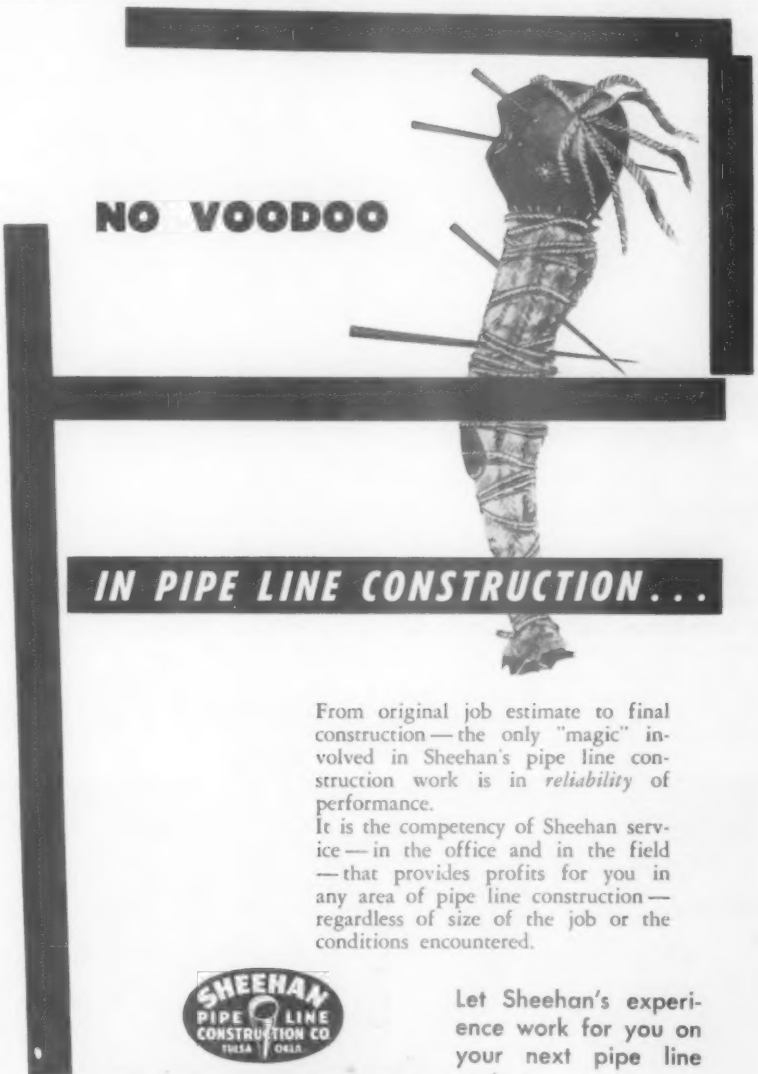
●

Panel Heating Coils which take the place of pipe coils for industrial heating and cooling processes are set forth in new four-page Bulletin 257. To form the coil, two metal plates are welded together, after one or both are embossed. The embossed spaces form the flow channels. The bulletin furnishes sizes and prices for four types. It also includes design information and tells how to estimate heating-coil needs. **Write or call: Dean Thermo-Panel Coil Div., Dean Products, Inc., 616 Franklin Avenue, Brooklyn 38, N. Y., for Bulletin 257.**

●

Electrode Data Book NH-504 (24 pages) presents useful information on arc welding. The data, presented in easy-to-use tabular form, includes: (1) information on A.W.S.-A.S.T.M. arc welding electrode specifications and how to estimate electrode consumption; (2) a summary of welding symbols; (3) factors to consider in selecting electrodes, and (4) other data of interest to users of arc welding. **Write or call: National Cylinder Gas Co., 840 North Michigan Avenue, Chicago 2, Ill. for Electrode Data Book NH-504.**

Continuous-Flow Oxygen Analyzer described in new two-page Bulletin CEC 1841 is designed specifically for process-plant use. It employs a colormetric differential-photometer method for continuous detection and measurement of trace amounts of oxygen in gas streams. According to the bulletin, the analyzer will successfully monitor trace amounts of oxygen in most gas streams encountered in plant processing. The bulletin details the analyzer's applications, principle of operation, and advantages. **Write or call: Consolidated Electrodynamics Corp., 300 North Sierra, Madre Villa, Pasadena, Calif., for Bulletin 1841.**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IN PIPE LINE CONSTRUCTION . . .
From original job estimate to final construction — the only "magic" involved in Sheehan's pipe line construction work is in *reliability* of performance.
It is the competency of Sheehan service — in the office and in the field — that provides profits for you in any area of pipe line construction — regardless of size of the job or the conditions encountered.
SHEEHAN PIPE LINE CONSTRUCTION CO. TULSA OKLA.
Let Sheehan's experience work for you on your next pipe line project.
SHEEHAN
NATIONAL BANK OF TULSA BUILDING
TULSA, OKLAHOMA

EQUIPMENT MEN . . . in the News

Enjay Appoints Taylor As Butyl-Division Head

Gavin A. Taylor is now assistant sales manager of the butyl division of Enjay Co., Inc. Enjay is a petrochemicals marketing firm. Taylor joined Enjay in 1945 and was assigned to foreign work until 1952. After that he worked on new-product development until last July.

USS Names Fitch Assistant Pipeline Sales Manager

D. A. FITCH

The appointment of Donald A. Fitch as assistant manager of sales, pipelines, with headquarters in Pittsburgh, has been announced by W. J. McKee, general manager of sales of United States Steel Corp.'s National Tube Division. Fitch will be responsible for coordinating sales of trunk pipeline products in the marketing area served by National Tube.

Fitch came to National Tube in 1947 as a sales trainee and since then has been a salesman in the Denver, Colo., and Dallas, Tex., district sales offices.

Oil Personnel Tour Continental-Emsco Garland Plant

Personnel from several companies operating in Hobbs, N. M., and surrounding areas were flown in to make a tour and inspection of Continental-Emsco Co.'s D+B plant recently. The group of 19 men made the trip to learn first hand the manufacturing methods used in the Continental-Emsco plant at Garland, Tex.

Shown as they arrived at the airport, the following men made the tour: J. R. McGovern, Phillips Petroleum Co.; C. R. Kersecwa and W. R. Eddington of Gulf Oil Corp.; W. T. Baker and R. J. Christensen, Magnolia Petroleum Co.; L. E. Lott, Atlantic Refining Co.; L. W. Haney, Warren Petroleum Corp.; A. H. Rice, McAlester Fuel Co.; Bill Johnson, Continental-Emsco Co.; Lester Williams, L. E. Elliott Co.; Bob Hoover, Continental-Emsco Co.; Don Teague and J. Wootten, Texas Pacific Coal & Oil Co.; Joe Sherrill, Humble Oil & Refining Co.; J. E. Curzon, Phillips Petroleum Co.; Latham Ryan, Continental-Emsco; Carl Houser, Amerada Petroleum Co.; Forrest Woods, Pan American Petroleum Corp.; Lewis Kircher, Amerada Petroleum Co.; T. J. Thigpen, Pan American Petroleum Co.; and Paul Green, Humble Oil & Refining. T. H. Fraser, Continental-Emsco production machinery sales department manager; and G. H. Lewis, D+B sales department manager, greeted the plane.

Bovaird's Key Personnel Attend Annual Sales Meeting

The annual Bovaird Supply Co. sales meeting, held in Tulsa recently, was attended by 80 store managers, city and field salesmen, and others representatives from 28 offices and stores.

Principal speaker at the meeting was Dr. G. Herbert True, marketing professor at Notre Dame University. The three-day Bovaird meeting was presided over by Roscoe G. Ayers, vice president and general manager. President Davis D. Bovaird and other company officials addressed the meetings, including W. J. Bovaird, T. H. Trower, R. M. McMahan, R. E. Batchelor, F. J. Robbins, C. F. Hamm, T. C. McCuistion, M. B. Park, G. E. Ferguson and D. L. Dufford.

Dr. G. Herbert True of Notre Dame University discusses creative sales work with Davis D. Bovaird, president; W. J. Bovaird, R. E. Batchelor, Roscoe G. Ayers, T. H. Trower, and R. M. McMahan.

Lane-Wells Makes Location And Personnel Changes

J. W. Cobble has been reclassified to district sales engineer at Liberty, Tex., for Lane-Wells Co.; J. G. Hicks has been reclassified to station manager and transferred from Houston to Liberty; J. M. Myer has been reclassified to district logging and mechanical engineer, Houston.

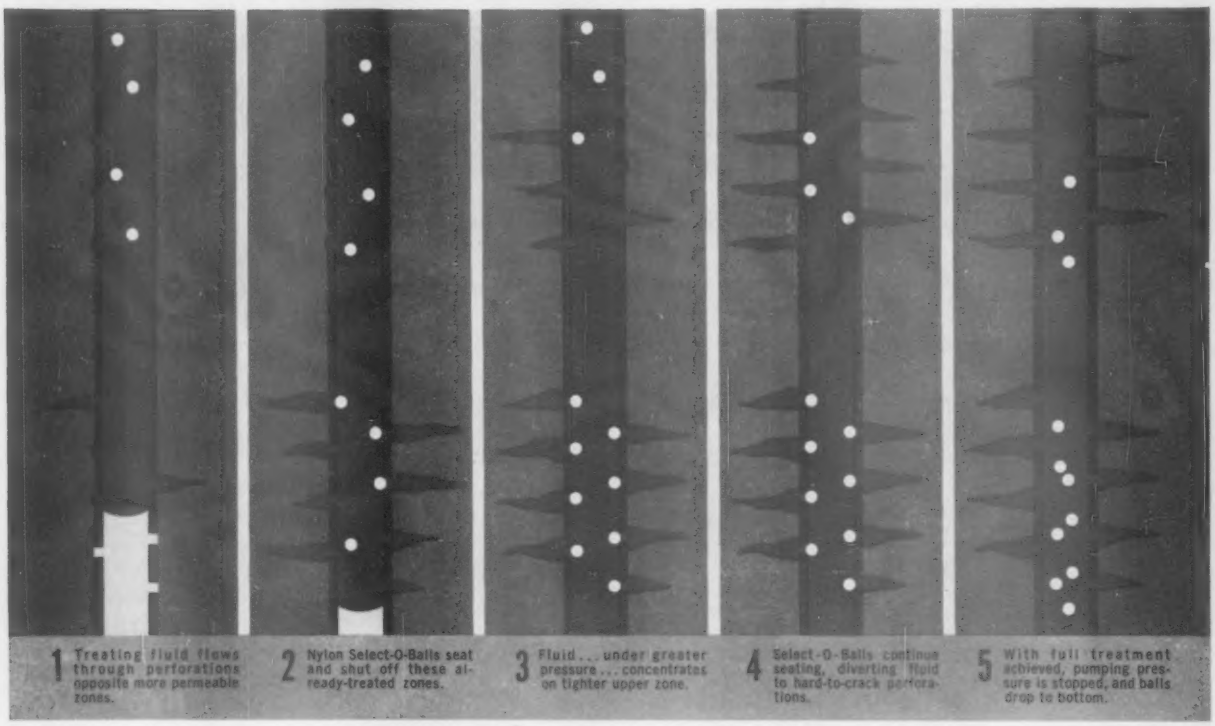
In Southwest Texas district, a new sales location has been established at Beeville. G. R. Hood was transferred to Beeville as district sales engineer. S. E. Garner was reclassified to district sales engineer, Luling; G. T. Gower was transferred from Alice to Luling as station manager; T. A. Wintz was reclassified to area manager, Alice; N. E. Wilson reclassified to district sales engineer, McAllen; the McAllen area was reclassified to the McAllen truck station and R. H. Ault transferred to McAllen as station manager. C. M. Willis was transferred to Pleasanton as operator-in-charge.

In the southern Louisiana district, a new sales office was established at Lafayette. V. L. Lavin is district sales engineer there.

In the West Texas district, M. C. Young was transferred to Odessa as assistant district manager of the West Texas district; K. D. Frick has been transferred to Seminole as district sales

Now fracturing and acidizing treatment can

PENETRATE ALL PERFORATIONS IN ONE STAGE *with* Select-O-Ball

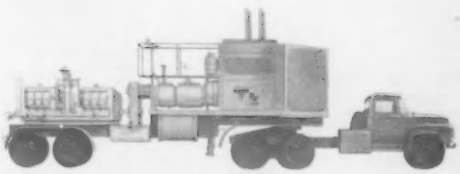

1 Treating fluid flows through perforations opposite more permeable zones.
2 Nylon Select-O-Balls seat and shut off these already-treated zones.
3 Fluid... under greater pressure... concentrates on tighter upper zone.
4 Select-O-Balls continue seating, diverting fluid to hard-to-crack perforations.
5 With full treatment achieved, pumping pressure is stopped, and balls drop to bottom.

Select-O-Ball Service opens drainage channels that can not be penetrated otherwise... provides maximum injection rate with minimum equipment.

Save up to 50%! Select-O-Ball Service allows one-stage treatment—saves rig time, saves multi-stage treatment costs, eliminates drill-out operations and cost of packers and bridging plugs.

Jet or bullet perforated casing may be treated—in open casing, down the annulus, or through open-ended-tubing.

Ask your BJ Service or Chemical Process field office for full details TODAY.



New 900 hydraulic horsepower BJ Service—Chemical Process 113-ST fracturing unit.

CHEMICAL PROCESS BJ Service

SUBSIDIARY OF BORG-WARNER CORP.

BJ SERVICE, INC.

General Offices and Laboratory—Long Beach, California

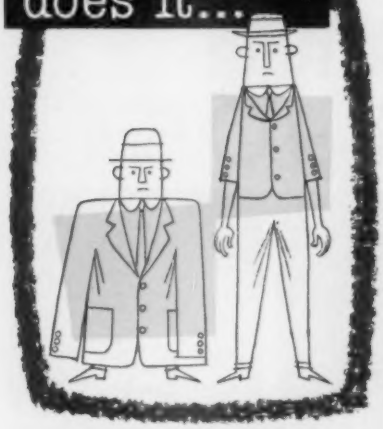
Stations Throughout California, Rocky Mountain and Permian Basin Areas

Chemical Process

General Offices and Laboratory—Breckenridge, Texas

Stations Throughout the Mid-Continent Area

no one coat does it...



one source does

Valdura offers maintenance paints made from specific resins for every condition

EPON

VAL-CHEM. Versatile, chemical resistant metal primer for use under any finish coat. VALPON ENAMEL. Prevents damage by oils, solvents, alkalies and other chemicals on wood, metal or masonry.

PARLON

PARAVAL ENAMEL. Not affected by acids, alkalies and other chemicals. Used on wood, metal, concrete or masonry. RUBBER BASE ENAMEL. Combines excellent exterior durability with high chemical resistance.

BAKELITE

SUPER SERVICE ENAMEL. Resists chemical, moisture and abrasive conditions on metal wood or masonry. ASPHALT ALUMINUM PAINT. 98% waterproof metal coat prevents rust, rot, corrosion. Highest reflectivity.

COAL TAR

SEWAGE DISPOSAL BLACKS. Used for protecting concrete and metal surfaces from water, etc., found in sewage plants, reclamation projects, refrigeration systems, metal and concrete pipe, marine exposures.

URETHANE

URAVAL. The very latest type of coating that combines the ultimate in resistance to chemicals, solvents, marring and abrasion. Uraval will stand up where all other types of coating have failed.

ALKYD

M & F ENAMEL (General Maintenance), VALKOTE (Implement Enamel), DARYWHITE. Products that utilize the outstanding durability of alkyd resins. All these coatings are hard, tough, quick drying and color retentive.

Valdura maintenance paints are stocked by leading industrial distributors everywhere!

VALDURA PAINTS THAT ENDURE

VALDURA
HEAVY DUTY
PAINT DIVISION
AMERICAN-MARIETTA CO.
101 E. Ontario St., Chicago 11, Ill.
687 Wellington St., Ottawa, Canada

engineer; N. J. Milliman has been transferred to Hobbs as district sales engineer.

Flori Appoints District Managers, Representative

Paul D. Broussard of Houston now represents Flori-Houston Pipe & Steel as district sales manager for the Houston area; William E. Keim has been appointed New York district sales manager; and Herman C. Heink has been appointed Midwest district sales representative. These appointments were announced by Robert D. Flori, president.

P. D. BROUSSARD

W. E. KEIM

Broussard's function as Houston district sales manager will include orders to be filled by either the Houston or St. Louis plant, according to customer convenience. He has been connected with the sales organization of Houston Pipe & Steel for 5 years.

Keim will coordinate sales activity in the New York area for both the St. Louis and Houston operations. He held several engineering positions before joining Flori Pipe in its estimating-engineering sales department.

Heink will coordinate sales activity in the Midwest area. He will make his headquarters at the Flori offices in St. Louis but will take orders for either the St. Louis or Houston plants.

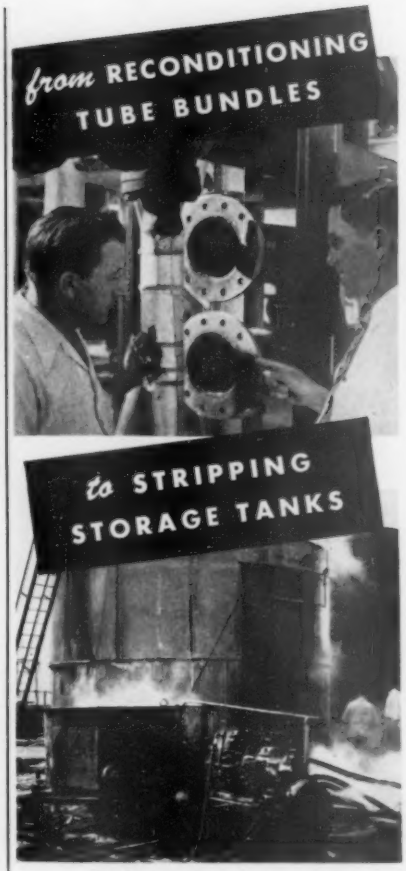
The Flori-Houston Pipe & Steel organization is the pipe-fabricating operation of Sparton Corp., Jackson, Mich.

Food Machinery & Chemical Acquires Oil Center Tool

Food Machinery & Chemical Corp.'s acquisition of over 98 per cent of the 90,000 outstanding shares of Oil Center Tool Co. of Houston has been announced jointly by FMC Executive Vice President Ben C. Carter and OCT President John F. Maher. The transaction was completed by a share for share exchange of FMC common stock for the outstanding shares of Oil Center Tool.

Oil Center Tool, incorporated in 1929, is a major producer of wellhead equipment to control flowing oil and gas wells.

FMC officials say the new acquisi-



. . . Oakite cleaning delivers better results faster

Clogging soils, rust and limescale vanish under the action of specialized Oakite materials circulated through exchanger tube bundles "in place". Eliminating time and work of pulling out bundles saved one company $1800.

Storage tank size is no obstacle to stripping paint with speed, when a two-man maintenance crew uses the Oakite mechanized "flow-On" method. Equipment for the flow-on method can be fabricated in your own machine shop from blue prints supplied free by Oakite.

These are just two of a whole range of maintenance cleaning jobs that can be simplified through the Oakite man's experience and the many materials, methods and equipment he can put to work for you. Bulletin F-7629 tells more. Write Oakite Products, Inc., 44C Rector Street, New York 6, N. Y.

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THE HOMCO REPLACEABLE BLADE STABILIZER AND STRING REAMER

Mr. Toolpusher:

The Homco Stabilizer allows normal drilling weight on the bit to permit faster penetration for vertical hole drilling, and insures that the angle of the bore-hole is kept well within contract limits.

The Homco Stabilizer is used extensively in Directional Drilling to stabilize the drill collar section for maintaining a desired direction and angle. The stabilizer prevents drill collar wall sticking and eliminates the danger of pulling drill collars into a key-seat. The Homco Stabilizer is your most economical insurance against the hazards encountered in crooked and straight hole drilling.

Where the formations are extremely difficult, we recommend the use of Homco Klustrite® blades. The blades can be changed on the rig floor in a matter of minutes.

Write for technical bulletin

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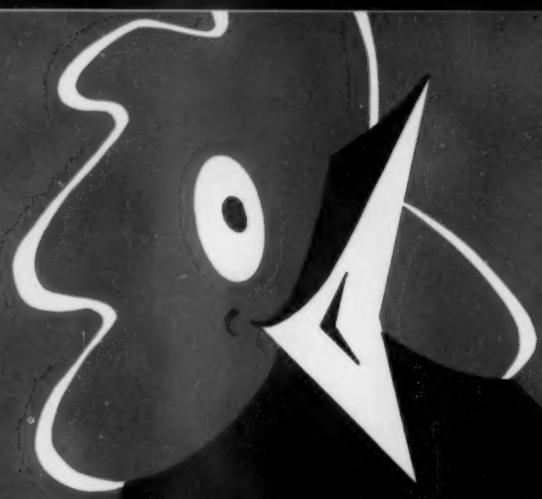
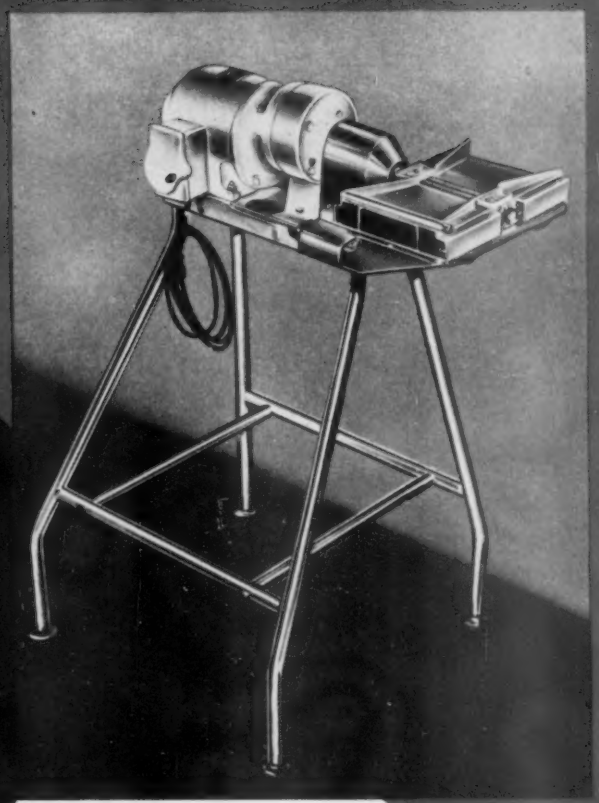


THERE'S MORE THAN ONE WAY TO SKIN A GIZZARD!



Power Gizzard Skinner Means Better Production for packers! Driven by a Master ¼ H.P. Double Parallel Gearmotor, output speed 230 R.P.M.

ANOTHER DRIVE REQUIREMENT MEETS ITS MASTER

"But my drive problems are different," you say, and right you undoubtedly are. Far as we know, this Master-powered Gizzard Skinner is unique.

But here's the point. America's productive genius consists of the ability to analyze a problem, devise a system and apply power to it in such a way as to produce better results faster at less cost. And *that problem* we bet you've got!

Let us help! Tell us the problem. From the drives listed here—or a combination of the required ones in one compact efficient unit—we'll deliver the goods! That's just what we've done for many, many years, to an ever-enlarging cross-section of American industry jealous of the performance of their motor equipment.

Motor Ratings..⅛ to 400 H.P. All phases, voltages and frequencies.

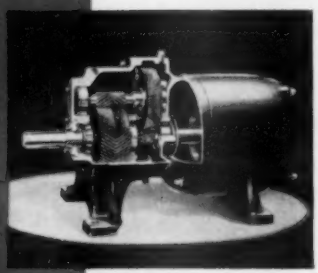
Motor Types.....Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.

Construction.....Open, enclosed, splash-proof, fan-cooled, explosion-proof, special purpose.

Speeds.....Single-speed, multi-speed, and variable speed.

Installation.....Horizontal and vertical, with or without flanges and other features.

Power Drive Features.....Electric brakes (2 types)—5 types of gear reduction up to 432 to 1 ratio. Mechanical and electronic variable speed units—fluid drives—every type of mounting.



THE MASTER ELECTRIC COMPANY

Dayton 1, Ohio

tion is a result of the company's planned expansion in the petroleum-equipment industry. FMC products such as pumps, wing unions, swivel joints and a variety of specialty items are rapidly becoming a principal product area of the company's machinery operations.

Oil Center Tool Co. will function as an FMC subsidiary operation with no changes in management contemplated.

Sutherland and Wagner Moved Up by S.K.F.

SUTHERLAND

E. H. WAGNER

It was announced that James H. (Jock) Sutherland is now director of sales, and Edward H. (Ted) Wagner is midwestern regional sales manager for S. K. F. Industries, Inc. Stuart H. Smith, vice president, sales, made the announcement.

Sutherland has been associated with S.K.F. in sales and engineering capacities for over 13 years. He has been senior division engineer, field engineer, district manager in Pittsburgh and Chicago, and most recently midwestern regional sales manager.

Wagner has been with S.K.F. for 16 years. He has been manager of marketing and moves to Chicago to become midwestern regional sales manager.

Emsco Screen Pipe Co. Occupies Larger Facilities

Pictured here is the new Houston plant and office building of Emsco Screen Pipe Co., manufacturers of oil-well and water-well screen pipe since 1923. The shop facilities cover 20,000 sq. ft. with modern equipment and machinery for handling pipe and processing it on a production-line basis.

R. D. Farish is president of the company and L. B. Crosby is vice president. G. R. Moss is manager of production for the plant; Charley Fake, assistant manager of production; and H. C. Burghard, assistant secretary. Val R. Wittich, Inc. handles export for the company.

Ross Fills Key Posts in Expanded Sales Department

Paul W. Wilcox, George G. Van Tuyl, Marvin F. Schobert, Richard J. Riedl, Lawrence M. Fletcher, and William G. Ritchie have been appointed to key posts in the recently expanded sales department of Ross Heat Exchanger Division of American-Standard, Buffalo, N. Y., according to Don L. Clithero, manager of marketing and sales. The new administrative positions enable the division to put into effect a three-group plan of selling, market planning, and marketing administration.

Wilcox has been named sales manager; Van Tuyl, manager of power equipment sales, eastern region; Schobert, product manager, Standard exchangers; Riedl, product manager, engineered, Navy and atomic exchangers; Fletcher, product manager, feedwater heaters; and Ritchie, product manager, surface condensers and ejectors.

Wilcox, formerly product manager of engineered exchangers, has been with Ross since 1944. Van Tuyl, transferred from the New York district office,

J-M Asbestos and Tar Felt

C-R-C Glass Wrap

C-R-C Outer Wrap

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FROM ONE SUPPLIER

Now you can fill all your pipeline needs from pipe wraps to pipe "pigs" from ONE supplier, Crutcher-Rolfs-Cummings, Inc.

C-R-C has chosen only the finest equipment and supplies for distribution to the pipeline industry. You have a choice, too:

15, 20, or 25 mil Glass Wrap
8 or 15 lb. J-M Felt
12 lb. Outer Wrap
2" to 36" O. D. Casing Insulators
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Take advantage of faster service by grouping your complete supplies order with C-R-C.

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Cleaning and Priming Machines
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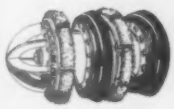
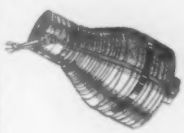
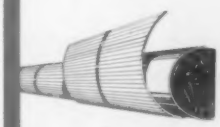
Esco Buckets and Teeth
C-R-C IMCO Bevelers
C-R-C Dope Kettles
T&R Holiday Detectors

Casing Insulators


Scraper "Pigs"


Casing Seals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W-S Forged Steel Fittings

Now protected with...

new blue rustproof coating

That attractive color you see on our forged carbon steel fittings is a new synthetic coating that effectively protects the fittings against corrosion in stock and in service. The coating completely covers the fittings—inside and outside, thus protecting threads and sockets, as well as external surfaces.

If you are going to paint your piping system for color coding or other reasons, the new coating serves as an excellent base for paint. No objectionable rust or scale to scour off before painting.

All W-S forged carbon steel fittings, in both screw-end and socket-welding types, are now available with the new blue rustproof coating.

Remember the blue color. It labels the fitting a W-S Quality Product.

Send for your copy of Forged Steel Fittings Catalog A-3-56

Write to W-S Fittings Division, H. K. Porter Company, Inc., P.O. Box 95, Roselle, N. J.

HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

joined Ross in 1944. Schobert, with Ross since 1941, has served recently as assistant manager of the Chicago district office.

Riedl was formerly assistant product manager of engineered equipment and has been with Ross since 1950. Fletcher came to Ross in 1954 from Alco Products, Inc. Ritchie joined Ross in 1956.

Smith Joins Eastman as General Sales Manager

R. M. SMITH

The appointment of Robert M. Smith as general sales manager of Eastman Oil Well Survey Co. has been announced by H. John Eastman, president. Prior to joining the Eastman organization, Smith was connected with Cardwell Manufacturing Co. for many years in a like capacity.

Welex Appoints Two in Gulf Coast Division

O. H. MENKE

L. A. COBB

Otto H. Menke has been named sales engineer for the Lake Charles, La., district, and Lewis A. Cobb has been appointed Gulf Coast division radioactivity logging engineer, by Welex Jet Services, Inc.

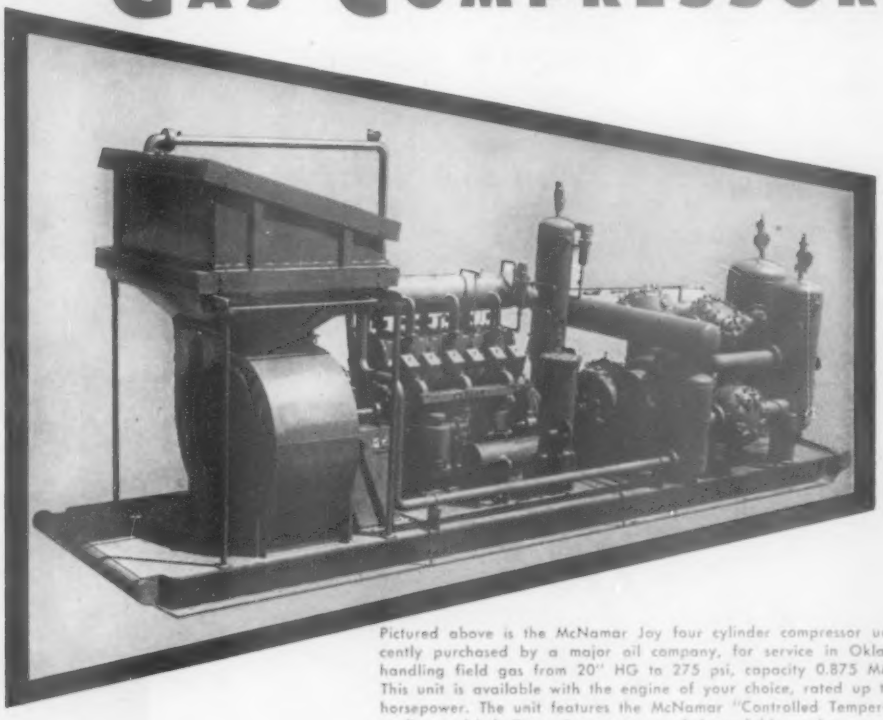
Menke has over 12 years in oil-well service work; the past year he has been with Welex in various field jobs. Cobb joined Welex 4 years ago and worked as a radioactivity logging operator before becoming the division R/A engineer.

J & L Supply Names Six As Sales Representatives

T. W. Small, Carl J. Bates, Robert F. Bunce, Albert A. Darby, Don T. Henderson, and John L. Leimbrook have been appointed as sales representatives by Jones & Laughlin Supply Division, Tulsa, according to W. L. Wolfe, vice president of sales.

Small, formerly manager of J & L's supply store at Longview, Tex., has been promoted to salesman at that lo-

McNAMAR-JOY
GAS COMPRESSORS



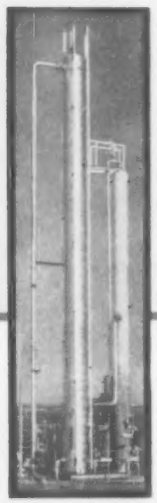
Pictured above is the McNamar Joy four cylinder compressor unit recently purchased by a major oil company, for service in Oklahoma, handling field gas from 20" HG to 275 psi, capacity 0.875 MMCFD. This unit is available with the engine of your choice, rated up to 400 horsepower. The unit features the McNamar "Controlled Temperature" cooling and is built to give you years of dependable service.

McNamar Joy-Gas Compressor units are available in one, two or four cylinder models. The four cylinder unit is rated up to 400 horsepower with one, two, three or four stages of compression, developing pressures up to 2,000 psi. The overall weight of this unit is 45,000 pounds.

Single cylinder, single stage units are rated to 100 horsepower. The two cylinder, single or two stage units are rated to 200 horsepower.

The McNamar-Joy unit is complete with rugged Joy compressor, gear reducer or belt drive, engine, cooling system, scrubbers, piping and safety controls mounted on a single structural steel skid.

The unit is extremely portable and can be moved on a tandem semi-trailer without disassembling. The arrangement of the equipment allows easy access to all parts for low maintenance costs.



McNamar Portable GASOLINE PLANT

The McNamar portable gasoline plant is designed for flexible application and automatic operation. Simplicity of design assures dependable operation and low maintenance costs.

The McNamar-Joy Compressor Unit is low in cost and is available on purchase, rental, or rental purchase option basis.

Call, write or wire McNamar Compressor Division for further information.

De-Sulphurization Plants Glycol and Solid Dessicant Units

McNAMAR BOILER & TANK CO.

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McNAMAR TULSA

business on the move

DEMANDS MOBILE HOUSING

You don't have to build and abandon expensive field camps anymore. You can keep your housing right with you, moving with your business . . . your employees will be happier with their families . . . and they can't be better accommodated than in SPARTAN mobile units.

SPARTANS are built for rugged use . . . riveted, all-aluminum construction . . . with the finest interior design and appointments for family living . . . practical comfort and convenience for field offices, kitchens, diners, bunk houses, and other custom units.

Some of America's greatest companies have turned to SPARTAN for the best in custom design for particular jobs. ✳

✳ Williams Brothers, internationally-known pipeline construction firm, will be using 57 SPARTAN mobile units for various field housing purposes on a pipeline job in Turkey.

SPARTAN IS THE ECONOMICAL ANSWER

SPARTAN
AIRCRAFT COMPANY
MOBILE HOMES DIVISION
1919 NORTH SHERIDAN ROAD
TULSA, OKLAHOMA

cation. Bates, Bunce, Darby, Henderson, and Leimbrook have been assigned as representatives at store points at Great Bend, Kans.; Williston, N. D.; Houma, La.; Shreveport, La.; and Alice, Tex., respectively.

Small joined the oil-field supply firm in 1940 as a storeman. In 1945 he was appointed local store manager at Oil City, Miss. He remained at that location until his transfer to Longview in 1951.

Crose-Curran Appoints Brand Vice President

J. W. BRAND

J. W. Brand has recently been appointed vice president of Crose-Curran, Ltd. in Edmonton, Alta., Canada. The announcement was made by D. M. Curran, president of M. J. Crose Manufacturing Co., Inc., Tulsa. Crose-Curran, Ltd., distributor for the Crose company, is a large Canadian supplier of pipelining equipment. Brand will be in complete charge of the Canadian operation with headquarters in Edmonton and branch warehouse in Winnipeg, Man.

Brand joined the Crose company in 1953 as a sales engineer. He had previously been a field representative for Williams Brothers Co. and also general manager of Brand Dispatching Co. in New Orleans.

Bethlehem Makes Division And Personnel Changes

Bethlehem Supply Co. has consolidated its Central division office, previously located in Tulsa, and the Fort Worth sales office. The offices are now in the Continental National Bank Building, Fort Worth.

In charge of the new installation is Arthur Weber, Central division sales manager. Other Bethlehem personnel attached to this office are D. C. Thomas, resident sales manager; H. V. Harder, division tubular sales manager; and C. E. Medley, special representative.

D. A. Irelan has been promoted to store manager and field representative at Thermopolis, Wyo. M. R. Griffith has been transferred from the Southwest Texas district to the Gulf Coast division office as machinery sales representative. He will headquarter at Houston. Griffith is replaced at Corpus Christi by J. J. Caskey, former machinery sales representative at New Iberia, La.

Visco Plans to Build New Texas Plant

Plans for the construction of a new million-dollar plant to produce oil-industry chemicals have been announced by Visco Products Co., a unit of National Aluminate Corp. J. A. Holmes, president of both Nalco and Visco, stated that directors approved the expansion program at a recent meeting.

The new facility will be located at Sugarland, Tex., adjacent to Visco's Plant 1. Construction will begin as soon as practicable, according to Holmes, and the tentative schedule calls for completion about January 1958.

Visco's three principal product lines will be manufactured in the new plant. Visco also operates a plant at Anaheim, Calif., where it produces oil-industry chemicals. The company's general offices are in Houston.

Jet-Lube Appoints Rocky Mountain Representative

The appointment of Roger Smith, Casper, Wyo., as representative of Jet-Lube oil-field drilling compounds and thread lubricants for the Rocky Mountain area has been announced by Frank

EQUIPMENT
with Engineering
SERVICE
METER RUNS
MECO Standard Meter Runs conforming to A.G.A. specifications are made in our own fabricating shop of materials carried in stock. —Seamless steel pipe, Tube Turn welding fittings, Forged steel flanges, and Commercial Orifice fittings. Meter Runs are available bored and honed, coated bore for corrosive service, and to special designs.
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What do you want in WELDING FITTINGS?

For any welded piping job you want fittings that fit — no disgusting last-minute complications.

You want fittings made of materials that measure up to your specifications — no mysterious failures.

You want a source for special as well as regular fittings. You want to avoid unnecessary welds, makeshift expedients, clumsy combinations.

You want to avoid procurement ordeals — the business of trying to make yourself understood. You want to do business with alert men who speak your language — engineers if you need them.

And — you want to know your business is appreciated.

The best answer to your welding-fittings wants, of course, is in your nearby J&L Supply store.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

SERVING THE UNITED STATES AND CANADA

27-G

Bergeron, vice president of Jet-Lube, Inc.

Jet-Lube thread compounds and other oil-field lubricants are sold exclusively through supply stores. Smith will maintain a warehouse stock at Casper.

National Supply Names Panhandle Manager

Walter E. Barnes has been appointed district manager of the newly created Panhandle district of the Midwest division of The National Supply Co. He will have his headquarters at Amarillo, Tex. The new district comprises the top 20 counties in the Texas Panhandle, the Oklahoma Panhandle, and sections of western Oklahoma and western Kansas.

Barnes started with National Supply in 1945 and has served as store manager at Stafford, Kans., and Elk City, Okla. Since 1955 he has been a rotary equipment salesman for the Midwest division.

Independent Exploration Promotes A. D. Dunlap

A. D. DUNLAP

A. D. Dunlap, associated for 23 years with Independent Exploration Co., was recently made director of operations for IX. Before his promotion he was the manager of Independent Exploration's Canadian branch. The announcement was made by T. I. (Pop) Harkins, president.

As director of operations, Dunlap will be responsible for the activities of all domestic field crews and will help coordinate crew findings with requirements of the laboratory and interpretation department.

FWD Opens Duncan, Okla. Sales, Service Branch

Four Wheel Drive Auto Co., Clintonville, Wis., formally opened its new branch sales and service center at Duncan, Okla., recently.

The new FWD branch is designed to provide more complete sales, parts, and service facilities for users of the company's four and six-wheel-drive oil-field, utility, construction, firefighting, transport and other heavy-duty trucks.

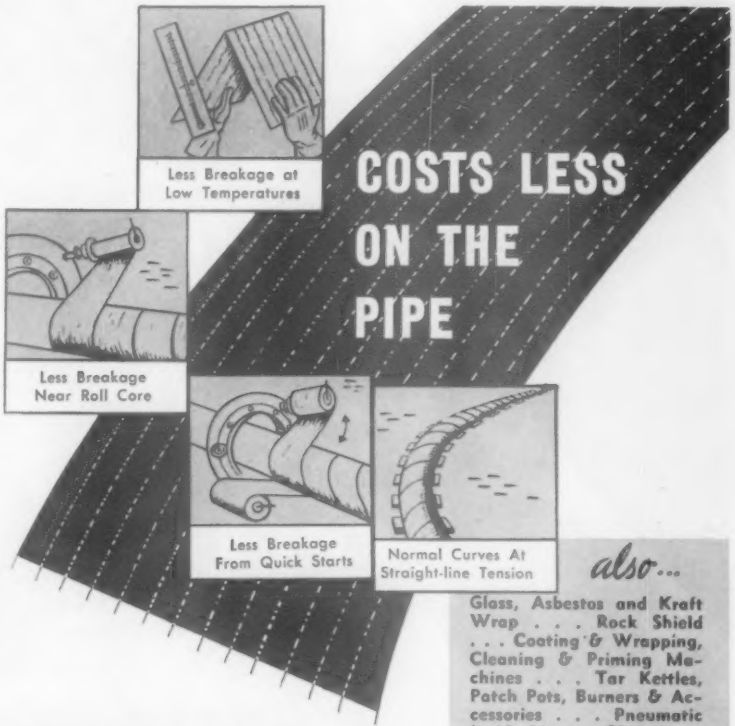
Klein of Herbert E. Hill Given OIC Service Award

Bernie Klein, vice president of Herbert E. Hill Advertising, Inc., was awarded a plaque for outstanding service to the petroleum industry during 1956 by the Southeast Los Angeles Oil Information Committee, a public relations branch of the American Petroleum Institute. Klein was cited for using his knowledge of advertising to further OIC's objective of helping win friends for the oil industry and emphasizing its character, citizenship, and sense of social responsibility.

Committee Chairman Bill Sinclair of Tidewater Oil Co. also was awarded a plaque. Besides Sinclair and Klein, outstanding service plaques were presented to George Carlisle, Pacific Pumps; Carroll Morrill, Standard Oil; Ray Powell, Shell Oil.

Transfer, Appointments Announced by Oilwell

Appointment of Curtis T. Deehr as district representative at Long Beach, Calif., has been announced by Donald S. Grubbs, manager of the California area of United States Steel Corp.'s Oil


Less Breakage at Low Temperatures
COSTS LESS ON THE PIPE
Less Breakage Near Roll Core
Less Breakage From Quick Starts
Normal Curves At Straight-line Tension

also...
Glass, Asbestos and Kraft Wrap . . . Rock Shield . . . Coating & Wrapping, Cleaning & Priming Machines . . . Tar Kettles, Patch Pots, Burners & Accessories . . . Pneumatic Inside Line-up Clamp . . . Pneumatic-tired Lowering-in Cradle . . . Pipe Cradles . . . Tongs, Sling Belts, Hooks, Clamps, Hand Tools, Supplies and Equipment of Every Sort.

PERRAULT 15 lb. FELT
Glass Fibre Reinforced

Perrault fifteen-pound asbestos pipe wrap is reinforced with longitudinal glass fiber strands at one-fourth inch spacing. It costs no more delivered to the job, but by eliminating most shut-downs due to breakage, it costs far less on the pipe. Since it is not brittle when cold. Perrault reinforced felt is especially recommended for Fall and Spring Projects where material will be kept in unheated storage. Let us show you a sample and quote your next job. We also offer the best in other pipe wraps: Owens-Corning Glass, Kerr-McGee Outer Wrap, Kraft, and the original Rock Shield.

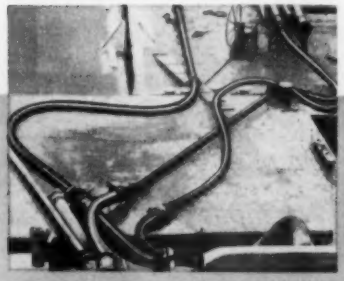
PERRAULT EQUIPMENT COMPANY
1130 N. BOSTON — TULSA, OKLA. — TELEPHONE LUther 5-1103

US RUBBER OIL TRANSPORT HOSE

Announcing

A COMPLETE LINE OF PETROLEUM TRANSPORT HOSE

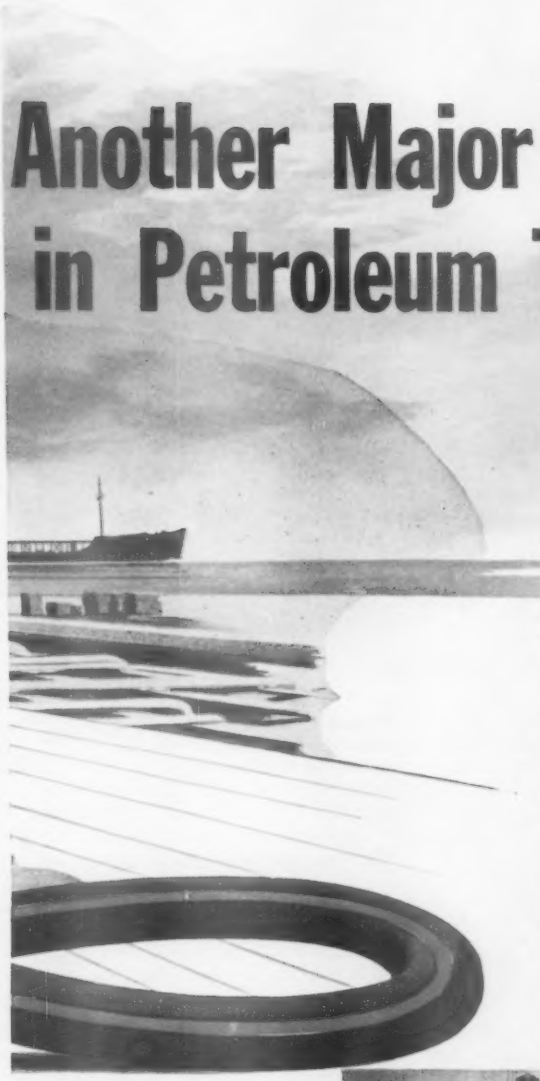
A hose for every purpose from U.S. Rubber...



FIRST with U. S. Amazon H-1515 Oil Discharge Hose.
Flexible smooth-bore, ⅖ lighter, takes up to 200 lbs. working pressure, needs less handling gear. Make-up time is reduced and accident hazards lessened.

FIRST with U. S. Amazon H-1818 Smooth Bore O S & D Hose.
Takes up to 200 lbs. operating pressure, withstands the roughest handling, has up to 100% greater hydrostatic values, extreme flexibility. H-1818 is the only burstproof smooth-bore hose.

Another Major Achievement in Petroleum Transport Hose



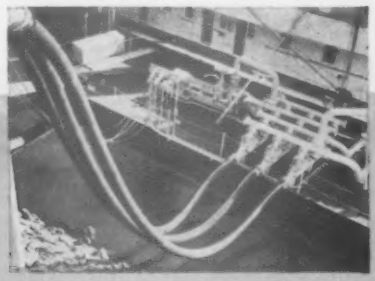
Now, from U. S. Rubber, the world's pioneer oil hose manufacturer, comes new additions to its line of Amazon® petroleum dock hose. There is a hose for every requirement—dock, barge loading and general loading services — rough bore or smooth, for extra high or normal working pressures.

Each hose has qualities that cannot be found in any other make hose of similar type — qualities of easier handling, greater flexibility, higher hydrostatic value — all of which make U. S. Amazon superior to any other hose on the market.

The new, complete line of U. S. Amazon petroleum transport hose is obtainable at any of the 28 District Sales Offices, or by contacting us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

AND NOW
TO COMPLETE THIS MOST UP-TO-DATE LINE OF DOCK HOSE, U.S. RUBBER IS ONCE AGAIN...

FIRST with U. S. Amazon H-2020 Rough Bore Oil Suction & Discharge Hose.
For 200 lbs. working pressure. Both inner and outer supporting wires double the hydrostatic values. Also suitable for hot asphalt and heated oils. Absolutely burstproof.



FIRST with U. S. Amazon H-2424 Rough Bore Wire Cord O S & D Hose.
For 150 lbs. working pressure, contains inner supporting wire in bore; specially designed carcass has each wire imbedded in its own neoprene layer. Conducts any petroleum product. Very flexible.

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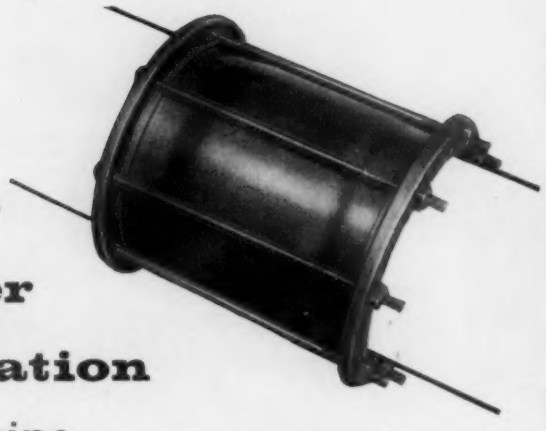

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You'll find plenty of uses for Dresser Couplings and Long Sleeves around a drilling rig . . . or anywhere else you join pipe.

That's because Dresser Long Sleeves make pipe joining so quick and easy. Pipe threading is eliminated. You simply slip on the sleeve and tighten with a wrench. Perfect alignment of pipe sections is unnecessary because the specially compounded rubber gasket permits up to 4° deflection at joints.

You get a permanent, bottle-tight connection every time—one that has the "give and take" necessary to absorb vibration, settlement and other stresses.

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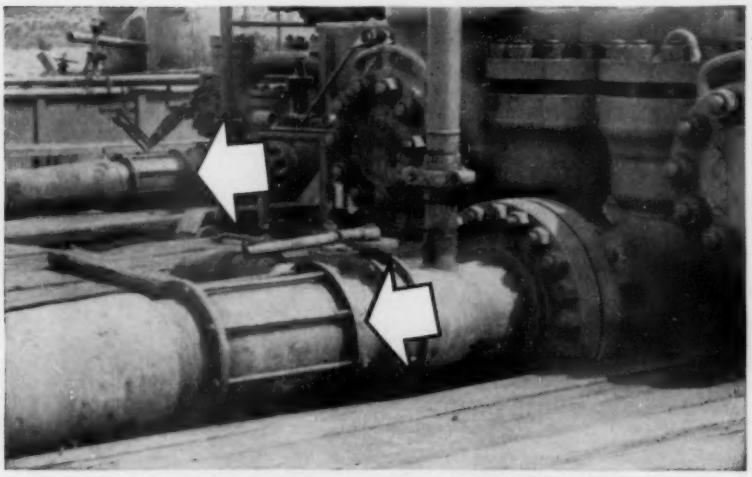

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Style 38 Coupling

Style 40 Long Sleeve

Hydrepair® Asbestos Cement Pipe Clamp

Style 63 Expansion Joint

Style 39 Insulating Coupling

Well Supply Division. The appointment of Bobby L. Payne as field representative at Charleston, W. Va., has been announced by C. H. Maynard, eastern area manager of the division.

Naming of Donald G. Holloway as field representative at El Dorado, Ark., was announced by William Miskimins, Central Midwest area manager. The transfer of Carlton J. Roper, field representative, from Wewoka, Okla., to Ellinwood, Kans., was announced by Mark Barkhurst, Mid-Continent area manager.

Deehr was employed by Oilwell in 1955 at Long Beach. Payne joined the division in 1954 at Charleston. Holloway has been with Oilwell since 1955. Roper was employed by Oilwell in 1952 at Wewoka.

SSC Appoints Palmer As Sales Engineer

J. E. PALMER

John E. Palmer has been appointed sales engineer for Seismograph Service Corp. to handle selling of the firm's geophysical equipment.

Gerald H. Westby, president, made the announcement following the decision of the company's board of directors to place SSC geophysical equipment on the open market. Westby said all types of SSC designed and manufactured equipment will be offered for sale.

Immediately prior to joining SSC, Palmer was Tulsa representative for Houston Technical Laboratories. Prior to that he had served with Humble Oil & Refining Co., and Carter Oil Co.

Midwestern Pipe Line Names Pittsburgh Manager

D. E. NEIL

The appointment of David E. Neil as district manager of the Pittsburgh, Pa., office of Midwestern Pipe Line Products Co. has been announced by John Wilson, vice president and sales manager of the Tulsa firm. Previous to joining the Midwestern organization, Neil had been associated with Radio Corp. of America in both its engineering and electronics divisions, in Cannonsburg, Pa.

Neil will head the sales representation for Midwestern in the Pittsburgh area in the sales and service of pipeline materials products. The firm has

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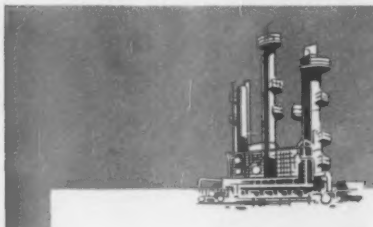

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We Can
Adapt It
to ANY
LIQUID LEVEL
CONTROL JOB

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Because of the utter simplicity and dependability of its magnetic principle, Magnetrol has *infinite operating life.* There are no wearing parts to get out of order.

Magnetrols are available for controlling level changes from .0025-in. to 150-ft., with single or multi-stage switching. Our experienced engineering staff is at your service.

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other branch offices in Portland, Ore., Mount Pleasant, Ill., Atlanta, Oklahoma City, Houston, and an export office in New York City.

Schmachtenberg Heads New Worthington Sales Dept.

Schmachtenberg

A. M. Tullo, vice president in charge of the Harrison division of Worthington Corp., Harrison, N. J., has announced the establishment of the industrial centrifugal compressor sales department.

This new department will bring under the Harrison division complete handling of industrial centrifugal compressors including engineering, manufacturing, and sales.

Everett C. Schmachtenberg, formerly assistant to manager of engineering at Harrison, heads this new sales department, according to C. K. Hood, vice president and manager of sales for the Harrison division.

Schmachtenberg has been with Worthington 19 years.

Nordberg Appoints Reed As Houston Sales Engineer

S. H. REED

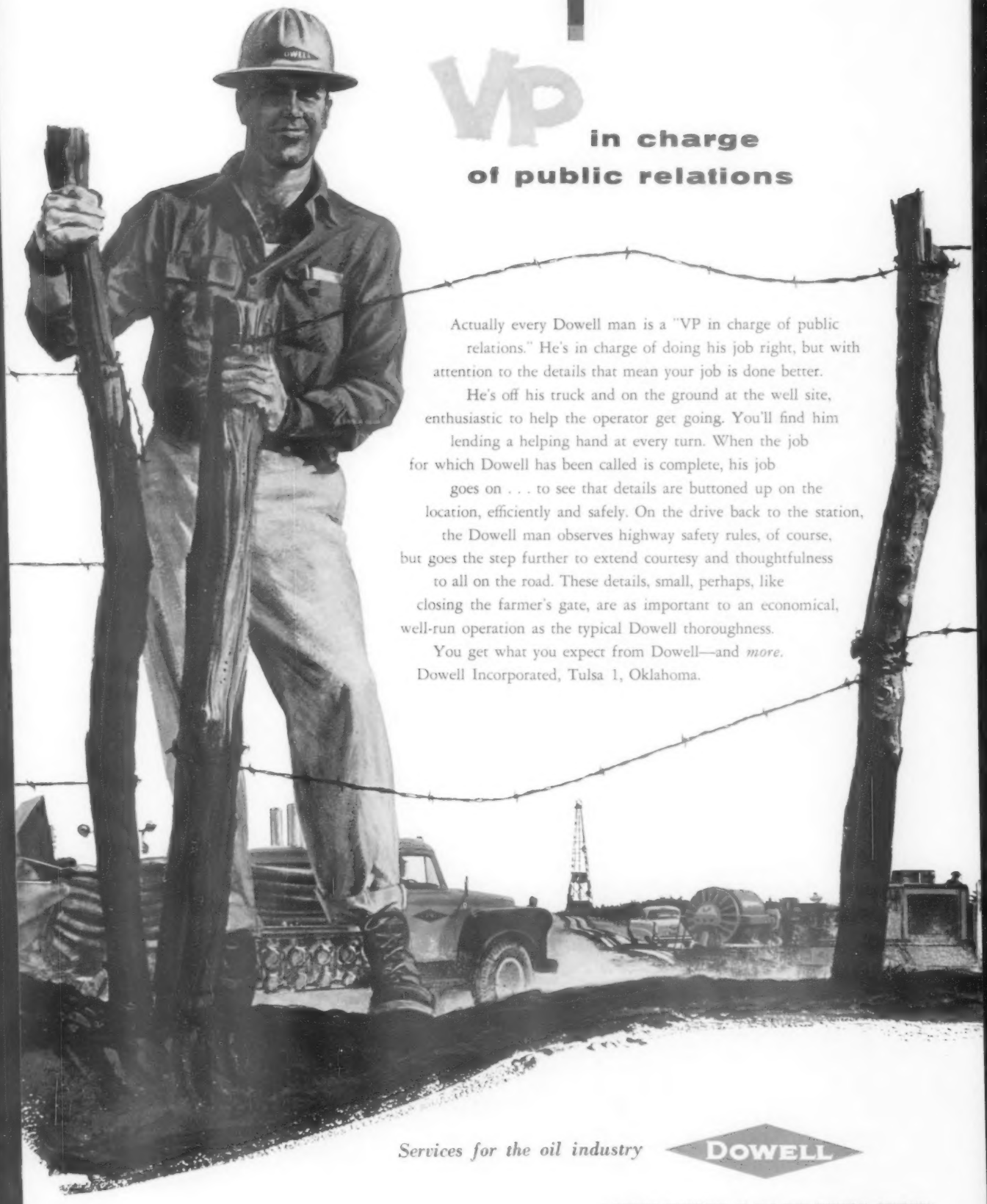
Appointment of Stephen H. Reed as sales engineer for Nordberg Manufacturing Co. has been announced by R. W. Bayerlein, vice president. Reed will make his headquarters at Houston and will work under the direction of Wayne Slife, district manager of Nordberg's Houston sales office.

Reed will place emphasis on engine applications for gas and oil pipeline pumping stations and marine installations. He recently served as district manager of the Tulsa office of Enterprise Engine & Machinery Co.

Kendrick Joins Lietz Equipment in Sales Post

Clovis F. Kendrick has joined the sales staff of Lietz Equipment Co., which represents Pelton, oil field division of Baldwin-Lima-Hamilton Corp. The announcement was made by C. H. Lietzow of Lietz Equipment.

Kendrick, formerly with Hydril Co., has been in West Texas 5 years and will continue to operate in this area. His headquarters will be in Odessa.



VP in charge of public relations

Actually every Dowell man is a "VP in charge of public relations." He's in charge of doing his job right, but with attention to the details that mean your job is done better.

He's off his truck and on the ground at the well site, enthusiastic to help the operator get going. You'll find him lending a helping hand at every turn. When the job for which Dowell has been called is complete, his job goes on . . . to see that details are buttoned up on the location, efficiently and safely. On the drive back to the station, the Dowell man observes highway safety rules, of course, but goes the step further to extend courtesy and thoughtfulness to all on the road. These details, small, perhaps, like closing the farmer's gate, are as important to an economical, well-run operation as the typical Dowell thoroughness.

You get what you expect from Dowell—and *more.*

Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

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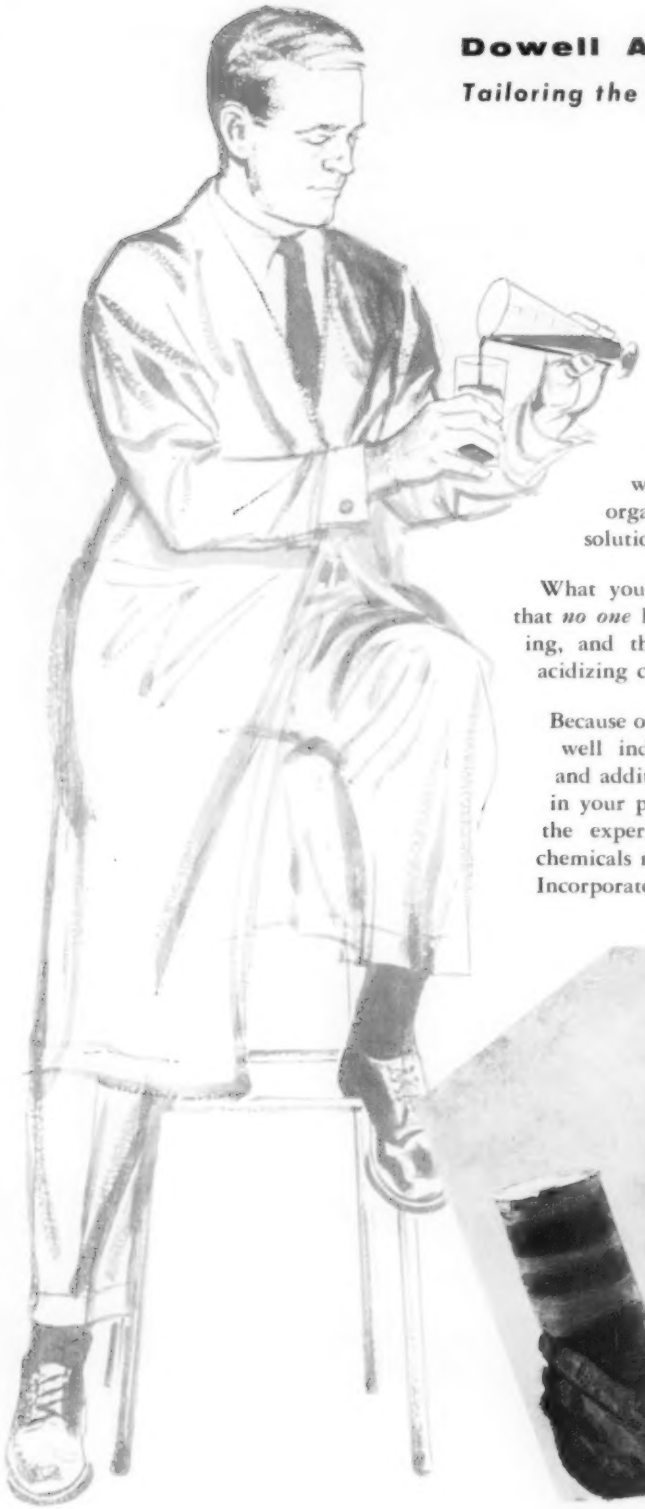
A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY



Dowell Acidizing Begins Here . . .

Tailoring the Right Acid Combination for Your Well

New chemicals to improve the results of acidizing treatments have been coming from Dowell research since 1932. And during that time Dowell service engineers have earned the practical knowledge that comes from long experience in doing a job well. From the moment the Dowell engineer begins working with you, you have the entire Dowell organization bending its efforts toward the solution of your problem.

What you get from Dowell, then, is the assurance that *no one* has had more experience in oil well acidizing, and that *no one* has a more complete line of acidizing chemicals.

Because of this background, Dowell can approach every well individually. The proper combination of acids and addition agents is tailored to give maximum results in your particular well. Dowell has the years of service, the experienced man power, and the wide range of chemicals needed to give you the best possible job. Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Misco Officials Assume New Posts

MAX BEREN

S. O. BEREN

A. A. STAUB

Max Beren, founder and president of Mountain Iron & Supply Co., has become chairman of the board and treasurer; S. O. Beren, formerly vice president and general manager, is Misco president; Allen A. Staub, formerly secretary, has become vice president and secretary. These moves were made at the annual meeting of Misco stockholders and board members.

Mountain Iron & Supply Co. was started in 1910 in Parkersburg, W. Va., by Max Beren. In 1917, when the El Dorado pool began attracting wide attention, Beren brought Misco service to Kansas, opening a supply store in El Dorado. Mountain Iron now has seven store locations in Kansas and offers the most complete service available.

Beren, as chairman of the board and treasurer for the concern, will continue to operate from Misco headquarters in Parkersburg. S. O. Beren has been vice president and general manager of Misco since 1946. As president, he will continue to operate from the Wichita office.

BJ Service Advances Hughes To Rocky Mountain Manager

C. Z. HUGHES

C. Z. Hughes has been promoted to Rocky Mountain division manager of BJ Service, Inc., it has been announced by W. T. Box, vice president in charge of operations. Hughes was formerly station supervisor for BJ in Ventura, Calif., and until recently, station superintendent in Long Beach. He will headquarter in the new Rocky Mountain division office which was recently moved from Billings, Mont., to Denver. He replaces John L. Buster, who has been reassigned to the Pacific Coast division.

J & L Names Lockett as Assistant Store Manager

The recent appointment of Henry P. Lockett as assistant local store manager at Odessa, Tex., has been announced by A. G. Bastian, manager of field sales division of Jones & Laughlin Supply Division, Tulsa.

Lockett, formerly a storeman at Odessa since 1952, joined J&L in 1936 as a storeman at the firm's oil-field supply store in Kermit, Tex.

Lunkenheimer Transfers Mahon to Houston Sales

Transfer of Vincent P. Mahon, sales representative for Lunkenheimer Co., from Chicago to Houston has been announced by Melvin W. Pauly, vice president in charge of sales of the Cincinnati, Ohio, firm.

Mahon, who replaces Tollie C. Venable as sales representative in the Houston territory, will cover that territory with Jack L. Green. Before becoming Chicago representative in 1956, Mahon was associated with Victaulic Co. of America as midwestern district sales manager for 6 years.

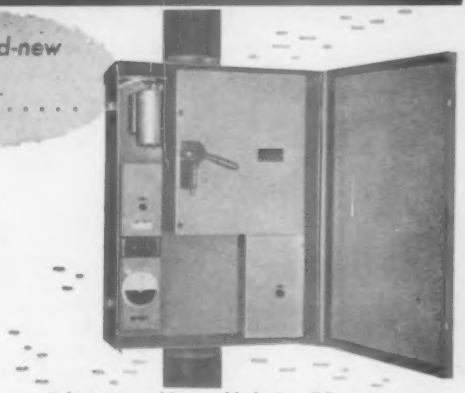
NELSON OIL WELL PUMPING CONTROL FOR FIELD PROVEN *Dependability*

with brand-new PLUG-IN features . . . . . .

DESIGNED EXPRESSLY TO PROVIDE DEPENDABLE CONTROL AND PROTECTION FOR ELECTRIC MOTORS OF OIL WELL PUMPING UNITS . . . . .

Completely new from top to bottom, this new Nelson Oil Well Pumping Control has many exclusive features such as (1) *plug-in* time switch with permanently installed dial trippers allowing 15-minute "on" or "off" operation; (2) *plug-in* undervoltage relay; (3) *plug-in* undervoltage relay with sequence starting; and (4) *plug-in* start-stop push button. Gasketed enclosure is dust-tight, and a separate ventilated compartment is provided for overload relays.

Ask your Nelson representative for complete information, or write for Bulletin 500.



Safety to personnel is assured by having all live parts covered with doors which are interlocked with main switch.

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of every working day . . .

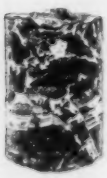
Core Lab starts a NEW JOB

At the end of 1953, Core Lab was beginning a new job every *forty-one minutes* of every working day. Today, the record reads — "every 21 minutes." What happens in a petroleum service company when its volume of service virtually doubles in three short years?

In Core Lab's case, this rapid growth has created an opportunity to broaden the benefits of commercial reservoir engineering. It has given us elbow room to challenge the increasing number of perplexing problems facing an operator in his search for new oil and its optimum recovery.

Specifically, Core Lab has re-invested this sound growth in — *comprehensive technical training for carefully selected field and lab personnel; the development of the industry's finest commercial Special Core Analysis Studies Group; the opening of twelve new permanent field laboratories; the use of electronic calculation equipment which, in combination with reservoir data from 62,000 wells, is unveiling facts of historic significance; the organization of a complete Reservoir Engineering and Consulting staff; the building of a fleet of modern, skid-type well logging units; the installation of a sand-packed column to predetermine results of various injection-and-recovery processes; the maintenance of a broad Research and Development program to handle specific area problems, etc. The list goes on and on.*

When we deliver *your job*, it has inherited the benefits of Core Lab's progress.



Have you seen Core Lab's three new folders — "Average Productive Characteristics of Oil and Gas Formations in Texas RR Comm. District IV"? Send request on your company letterhead to address below. Please mention this publication.

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Events happen fast in this area . . . so fast in fact that . . .

This Map Is Already Outdated

by John C. McCaslin

THE 19 drilling wells on the accompanying map are located in the nation's newest and most promising oil province . . . The Paradox basin of southeastern Utah. By the time you read this even more wells will speckle this portion of San Juan County.

The crescendo of Paradox events drowns out exploratory news in the nation. The oil finders in this vast Rocky Mountain basin have reaped the best discovery rewards for the industry since 1952, opening a long-awaited success cycle for the wildcat drill. With barely a year's work behind it, the Paradox search has tapped half a billion barrels of new oil. Things are happening so fast out in this once-scorned basin that any news story written is stale before it gets off the press. Here's what happened last week:

A new field . . . A Denver independent, Davis Oil Co., scored on its first Paradox shot last week at 1 Navajo-A, a Pennsylvanian wildcat in C NE NE 27-41s-24e, San Juan County. The prize was a Paradox oil discovery that flowed at the estimated rate of 45 bbl. per hour on drill-stem test of the Rockies' richest new pay zone at 5,510-90 ft.

First inkling of this latest discovery for the basin came early in the week when Davis released details on a core in the Paradox at 5,507-57 ft. The core had about 28 ft. of possible pay in vuggy limestone which was fairly porous and bled light-brown oil. Sample top of the Paradox is 5,393 ft.

The new field opener, which likely will be called East Desert Creek, is located about 4½ miles southeast of North Desert Creek field, 5 miles northeast of Desert Creek field, and 5 miles south of the main Aneth field itself. The closest well to Davis' discovery is a dry hole in NE 1-42s-24e. Continental Oil Co. farmed out the acreage for this test.

The best flow . . . Several days before Davis Oil Co.'s discovery, The Texas Co. upped the Paradox basin oil fever at its 6 Navajo-C, ¾ mile south of Aneth field production, with the best gage yet in the region. Texaco's well was completed for a combined flow of 3,462 bbl. per day from two zones in the Pennsylvanian.

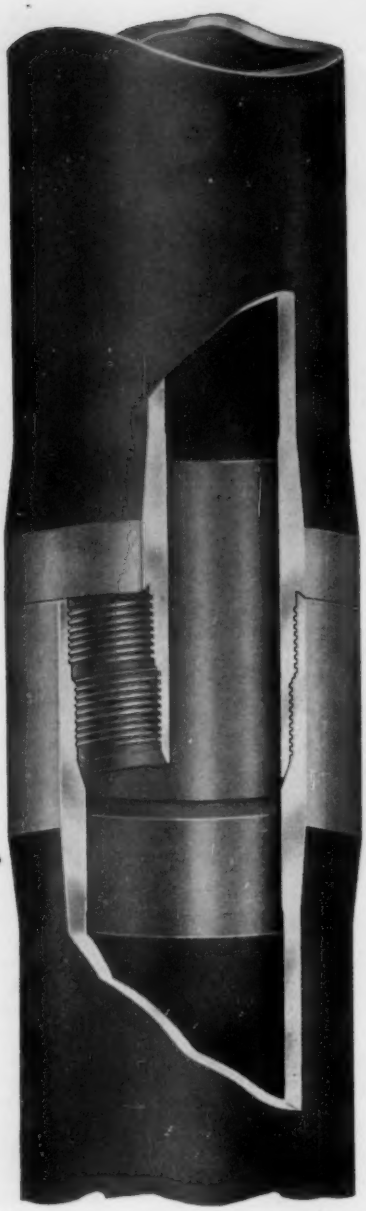
The oil flow from perforations at 5,602-20 ft. (the Ismay zone) was 1,806 bbl. per day on 1-in. choke; from perforations at 5,752-88 ft. (the Aneth zone) the flow was 1,656 bbl. per day on 1-in. choke. This prolific well has the distinction of being the first multiple-zone completion in the basin.

And more prospects . . . Important tests are under way at other Paradox basin wildcats from the top of the map at Gulf 1 Aztec-Montezuma down to the far southeastern corner of Utah in the Anido Creek and Four Corners sector.

At the far southwest corner of the booming Pennsylvanian play, U. S. Smelting, Refining & Mining Co. 1 Ohio-Navajo, 6½ miles west and north of North Boundary Butte, took a new gage last week, flowing gas at the rate of 9,735 M.c.f. per day from the Pennsylvanian. No tops have been released on this westernmost producer in the basin, but the pay is thought to be Hermosa.

Boom Paradox . . . This burgeoning basin now boasts 18 oil and gas fields . . . all of them produce from the Pennsylvanian Paradox and Hermosa. These two pay zones will outrun all others in the Rocky Mountain exploratory chase this year. The success ratio for San Juan County field development this year to March 1 is a flat 100 per cent; for wildcats drilled it is one out of three. It's hard to beat that score.

Paradox events don't come just once in awhile . . . they come by the dozen. The industry is uncorking one of the biggest potential oil reservoirs in the country. Last year was Paradox year . . . this year is Paradox year. Oil hunters in Bismarck talk about Paradox, even in the midst of important Williston happenings, it's on the tongues of Californians, and throughout the Rockies it has replaced the weather as top conversation in oil circles. If you like fast oil plays, keep an eye on this map . . . it's growing.



In a Speedtite joint, threads are cut on two diameters. This provides the strongest possible joint cut right into the upset metal. The thread on each step is straight—not tapered—so that its clearance is uniform, allowing for smoother make-up. All Speedtite casing threads of a size are interchangeable, thus eliminating need for crossover joints.

DEEP DRILLING

demands the best in casing ... and the best available is SPEEDTITE

Yes, Youngstown's Speedtite Oil Well Casing is the modern answer to problems encountered in drilling to greater and greater depths. When field conditions become increasingly difficult, specify Speedtite Casing because it:

- provides the necessary strength and ruggedness to take the increased punishment
- offers faster, safer, more economical setting of long strings
- guards against joint failures
- handles even the most difficult jobs with ease

For satisfactory field performance, Oil Country Tubular Goods must be of the highest quality. Recognizing this fact, Youngstown rigidly quality-controls all steps in its completely integrated operations.

From off-shore drilling sites to the deepest wells in the Southwestern oil fields, Speedtite is busy on the job. Why not let the Youngstown representative show you the many ways Speedtite can increase the efficiency of your operations?

CHECK THESE PRODUCTION ADVANTAGES OF THE *SPEEDTITE* EXTRA-STRENGTH JOINT!

Provides a 100% pressure seal against both internal and external pressures. It's leak-proof up to and beyond the casing's yield point.

Its increased strength over threaded and coupled joints ranges from 30% to 70%. Heavier casing can be run on the bottom of the string and lighter casing on the top—with ample tensile strength in all joints of the string.

A smaller outside diameter provides additional assurance casing will go to bottom. In some fields its smaller OD permits a reduction in hole size—thereby lowering drilling costs.

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S. E. G. ABSTRACTS

. . . taken from papers to be presented at the tenth annual midwestern meeting of the Society of Exploration Geophysicists

- **TIME—** March 13
- **PLACE—** Hotel Texas Fort Worth, Tex.
- **EVENT—** S. E. G. Meeting
- **PROGRAM—** Technical Papers

Distinguished Speaker Address

MARTIN DIES, United States Congressman from Texas.

An Electronic Seismic Dip Plotter

JAMES A. WESTPHAL, Sinclair Research Laboratories, Inc., Tulsa, Okla.

SINCLAIR has developed and has in use an electro-mechanical dip migrating machine which rapidly and accurately plots, in either time or depth, migrated dip segments obtained directly from conventional seismograms. This machine was designed to fill the need for the rapid construction of migrated dip sections from the very large number of records obtained in surveys in the offshore waters of Louisiana and Texas.

Although at the present time reconnaissance shooting has been largely completed in these offshore areas, the machine has proved very useful in detailed seismic reinterpretation.

Thrust Faulting in the Wichita Mountain Front

RICHARD RIGGS, Huffman & Malloy, Oklahoma City.

THE present Anadarko basin began its formation at post Morrow-early Pennsylvanian times resulting in basin subsidence adjacent to the Wichita Mountain uplift which resulted in an orogeny which produced thrust faulting and crust shortening adjacent to the south part of the basin. Cross-sections will be presented from the mountain complex into the south flank of the Anadarko basin through wells which have crossed the thrust fault.

The cross-sections will be generalized due to the complexities of the faulted, distorted attitudes of the beds below. The movements in the Wichita Mountains affected adjacent structures in the Anadarko basin.

Geophysical Characteristics Of the Midland Basin

JOHN DALY, consulting geophysicist and geologist, Midland, Tex.

THIS paper pertains to the eastern shelf area and of necessity deals in generalities. Factors involved in the use of the seismograph are principally getting records and interpreting them. The author points out the influence of the surface and subsurface conditions in obtaining usable seismograms.

The paper discusses the ability of the seismograph to solve stratigraphic problems in the Permian and Pennsylvanian formations. It is pointed out that the seismograph is essentially an instrument for measuring differential dip and the author presents the application of the seismograph as related to the structural problems throughout the Midland basin and eastern shelf area.

Case History of the Big Mineral Field, Grayson County, Texas

C. A. WOOD, review geophysicist, Shell Oil Co., Tulsa, Okla.

BIG MINERAL field is situated on an arm of Lake Texoma in Grayson County, Texas. Geologically it is in the Marietta syncline. Shell Oil Co. started seismic exploration in the Big Mineral area in 1947. The early seismic data did not indicate an attractive prospect because of the lack of control on the east flank of the prospect, which was under the lake. An abandoned test about 1 mile southwest of the present field was another discouraging factor before the prospect was tested.

After the discovery well was drilled, additional seismic control was obtained on the eastern flank of the structure. As finally mapped the structure consists of a faulted anticline.

Exploration Case History of the Anderson Ranch Field, Lea County, New Mexico

GLENN H. SWENUMSON, division geophysicist, Continental Oil Co., Roswell, N. M.

ANDERSON RANCH is a typically prolific oil field on the rapidly developing northwest shelf of New Mexico. The Anderson Ranch area was first pointed up as anomalous by a high Rustler anhydrite point in a shallow well drilled in 1927. In 1940, core drilling confirmed an anhydrite nose over the area. In 1950-51, a reflection seismograph survey encountered many difficulties obtaining usable records, but succeeded in mapping a closed anticline.

It is quite certain the deepest seismograph map was based on multiple reflections. Some comments are offered in this regard, and exaggerated "structure" produced by late-arriving multiple reflections is pointed out. The anticline was unitized and drilled, the discovery well being completed in the Devonian, for an initial production of 1,968 bbl. of oil per day.

Oil and Gas Producing Zones Of Southeastern New Mexico

RANDALL E. MONTGOMERY, State of New Mexico Oil Conservation Commission, Hobbs.

THE oil and gas-producing areas of Lea, Eddy, Chaves, and Roosevelt counties, southeastern New Mexico, are within the geologic province known as the Permian basin. This portion of the Permian basin is divided into several major structural units, being the Delaware basin, the Central basin platform, the northwestern shelf, the Artesia-Lovington trend, and the Lovington basin.

This paper covers the limits of these structural units of southeastern New Mexico plus their structural, stratigraphic, and productive history.

Signal to Noise Ratio Improvements By Correcting for Normal Stepout and for Variations Due to Weathering and Elevation

WILLIAM E. RICHARDSON, Continental Oil Co., Ponca City, Okla.

THIS paper is concerned with the effect of trace corrections when used with phase discrimination for improving signal-to-noise ratios on seismogram records. It is a qualitative treatment showing how actual field records were improved by applying static corrections to compensate for variations due to weathering and elevation, and dynamic corrections to remove normal stepout.

Directivity Effect of Elongated Charges

ALBERT W. MUSGRAVE, research geophysicist, Magnolia Petroleum Co., Dallas, Tex.

AFTER years of development it has been determined that the energy from the detonation of a low-velocity explosive in an elongated column approaches a unidirectional pattern. This column is placed in the subweathering material extending one-fourth to two wave lengths in length depending on the frequency of energy desired.

A study of the theory of propagation showed that greater directivity can be obtained from the same length of charge by using a powder with a detonation rate less than the side-wall

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velocity of shot hole. The optimum velocity between increased directivity and loss of energy of the charge, is about four-fifths of the side-wall velocity.

The reduction of horizontal energy is of great value. However, samples of the effect of the elongated charges indicate that a very important effect of directivity is the elimination of "ghosts." Interpretation may be greatly facilitated by the reduction of much of the unwanted energy on the record. Character is no longer dependent upon hole depth.

Geology of the Midland Basin

WILLIAM J. THOMPSON, geologist, Continental Oil Co., Midland, Tex.

THE Midland basin is an elongate asymmetrical downwarped closure which had numerous pre-Permian anomalies providing an irregular sea floor for the deposition of Permian sediments. The poorly defined boundary is often recognized by the changing from a more clastic Permian facies in the basin to a carbonate lithology in adjacent geologic provinces.

Oil and gas production can be attributed to structural and stratigraphic type traps, with stratigraphic conditions accounting for greater accumulation in the northern half of the basin.

This paper involves a brief discussion of the structure, stratigraphy, and production in the Midland basin area.

Getting Your Feet on the Ground Velocity-Wise

CHARLES H. THURBER, vice president, Empire Velocity Service, Odessa, Tex.

THE accepted standard-velocity survey is the vertical-well-geophone survey, and now used as the calibration device for continuous acoustic logs. The character of the well geophone breaks is considered very important and may yield important information in the understanding of reflection character. It is also suggested that well surveys be studied as refraction prospects.

The acoustic log is basically a tool for the seismologist and may yield to him more information for his work than the electrochemical and radioactive logs. The log for the seismologist is illustrated and an explanation of the components of the log is given. A corrected log is compared to a conventional velocity survey, and some very interesting correlations are illustrated. Ideal velocity changes affecting the logging probe are shown to illustrate the effect of the velocity on the log.

A Continuous Marine Seismic Surveying System for Mapping Shallow Reflectors

W. B. HUCKABAY and **C. D. McCLURE,** Magnolia Petroleum Co., Dallas, Tex. Paper presented by **C. D. McCLURE.**

A SYSTEM has been developed for continuously recording shallow seismic reflections in water-covered areas. A magnetostrictive acoustical source transmits a pulse into the water at a repetition rate of 12 per second and a hydrophone receives the reflected signals. A logarithmic amplifier and continuous chart-recording system are synchronized with the pulse source. Reflections from the sea bottom and from within the underlying sediments are displayed as a continuous record in variable-density form on electrosensitive paper.

This record section presents the various reflections as horizontal black lines on a lighter background in a manner similar to that of conventional fathometer recordings. In addition to this, the record is monitored on a cathode-ray oscilloscope. Both records may be viewed continuously by the operator as the boat navigates a prescribed course.

A film prepared by General Petroleum Co. of Los Angeles will be presented with this paper. The film deals with the working of the instrument and the coring operations to check the results. Klass van der Weg of General Petroleum will supply the commentary with the film.

The Gulf Seismic Profile Printer

E. M. PALMER, Gulf Research & Development Co., Pittsburgh, Pa.

A SEISMIC-RECORDING system has been developed in which seismic sections, printed photographically in variable-density form, simulate geologic cross-sections. The seismic signals recorded at geophone stations arranged for continuous reflection center-point control are presented in a sequence of vertical tracks. The tracks are adjusted for known corrections and reproduced at a selected horizontal scale.

Prints of the variable-density section exhibit all events and their interrelationships for ready recognition and appraisal. The printer mechanism reduces seismic information to a uniform time basis with weathering and elevation corrections to datum, and with step-out corrections in which account is taken of changing wave-front velocity with vertical travel-path arrival time.

The original field records comprise variable-density tracks on strips of 70-mm. film. In the printer, the record tracks are simultaneously corrected and transferred to a continuous sheet of film by contact printing. Punched cards feed correction data to the mechanism which operates automatically, but with provision for various special automatic functions under control of the operator.

Fault Map of South Louisiana

WILLIAM E. WALLACE, division geologist, Forest Oil Corp., Lafayette, La.

THIS paper deals with a map showing the subsurface faults in South Louisiana. The faults have been remarkably well substantiated by subsurface control. The fault study was made for the purpose of determining fault trends and their patterns in the southern part of Louisiana. It was also of interest to discover the relationship of the faulting to producing structures and to examine the regional pattern of the faulting. The author presents the latest version of his fault map.

The discussion pertains to why the fault trends occur and why they have certain orientations. Geophysicists have found the map extremely useful in planning seismic control for and finally delineating many areas of interest in South Louisiana.

Resume of Subsurface Geology Of Northeast Texas

ROBERT W. EATON, exploration manager, P. G. Lake, Inc., Tyler, Tex.

THE purpose of this study is to present a general review of the subsurface geology of Northeast Texas with the hope of contributing toward a better understanding of the complexities involved in recently discovered production trends. An attempt is made to review briefly the structural growth of the basin including a discussion of the gross lithology and distribution of the various rock units comprising the Pre-Cretaceous beds.

A summary of the producing capabilities and the future potential of these beds is given. The presentation is accompanied by index, general structure, isopach, lithofacies, and paleographic distribution maps, as well as structural cross-sections.

The Importance of the Structural Interpretations of Seismic Data

R. A. WEINGARTNER, geophysical coordinator, Pan American Petroleum Corp., formerly Stanolind Oil & Gas Co., Tulsa, Okla.

AT a time when complicated structural concepts appear to be the rule rather than the exception, too little effort is being spent on the study of stratigraphic and structural possibilities offered by the seismic cross-section data, and too little effort is spent by the geologist in making use of the data.

Steps to increase the effort envisage: (1) development of qualified personnel for structural and stratigraphic interpretation with responsibilities limited to the cross-section and map making; (2) construction of seismic cross-sections and display of seismic map data in the most usable form for all geologists; (3) a program to encourage the use of seismic file data and the insistence by the geophysicist that the geologist make use of the data on a constant and routine basis.

Illustrations are provided to show the inadequacy of our present effort and the need for cross-sections and seismic maps on a scale and in terms understandable by geological personnel of limited experience.

Experiments With a Two-Dimensional Seismic Model

W. T. BORN, Geophysical Research Corp., Tulsa, Okla.

A TWO-DIMENSIONAL seismic model has been used to study diffraction phenomena of two types; those associated with subsurface discontinuities, and those associated with surface irregularities. Model records will be shown to display diffraction at a fault zone and also to illustrate the effect of surface irregularities upon seismic record quality. An attempt is made to relate the results of model studies to practical field work.

Topography and Its Apparent Effect on Average Velocity (In an Area of Low Structural Relief in Oklahoma)

H. M. THRALLS, Thralls, Green & Perry, geophysical consultants, Tulsa, Okla.

THE more or less recent technical developments in seismic instrumentation has provided the geophysicist and geologist with some new tools of their trade. The spectacular nature of some of this gadgetry has contributed toward the trend to ignore some of the fundamental problems in interpretation which are not, and cannot be, solved by the use of improved recording devices.

The accuracy of geophysical interpretations in areas of good record quality and low-relief structure is dependent on the recognition of all the factors which can contribute to small differentials in reflection time and by the proper resolution of seismic data into accurate geologic conclusions. A geophysical prospect falling under the above category is reviewed wherein the effect of topographic overburden on average velocity appears to be one of the main factors contributing to time differentials.

EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

Wiser Oil Co. moved out better than 1 mile to the southeast of the new gas production in Chippewa Township and brought in a 3,600,000-cu. ft. well after fracture on 1 W. Weygandt, Section 7, Lawrence Township, Stark County. Red Clinton was found at 3,924-60 ft. with 210,000 cu. ft. natural.

• A half-mile stepout by Preston Oil Co. at Killbuck resulted in a 225-bbl. producer on 2 W. Waltman, Section 7, Killbuck Township, Holmes County. Clinton was logged at 3,535-81 ft. with a good showing natural.

• Natol 1 C. Files, Section 3, Chippewa Township, Wayne County, their second well in this part of the township, had Clinton at 3,760-3,804 ft. with 5 bbl. showing natural and 150 bbl. in 24 hours after fracture.

PENNSYLVANIA

In Armstrong Township, Indiana County, Southwest Pennsylvania, T. W. Phillips Gas & Oil Co. completed 1 A. W. Robinson, deep wildcat, gaging 6,115,000 cu. ft. gas after fracture. Onondaga 7,390 ft., chert 7,402 ft., Oriskany sand 7,532-55 ft., gas in this sand, total depth 7,565 ft.

• In Young Township, Manufacturers Light & Heat Co. 4427 R. & P. Coal Co. reached the Oriskany sand at 7,794-7,808 ft. with small show of gas and shut down at 7,824 ft. to fracture.

• Gaskill Township, Jefferson County, Columbian Carbon Co. 2-1837 Frank M. Sheesley is moving in spudder to bail and test after fracture which may have resulted in failure. The Onondaga was at 7,345 ft. and the chert 7,358 ft.

WEST VIRGINIA

In Gore district, Hampshire County, West Virginia, Columbian Carbon Co. 1228 Lonza Kidwell has resumed drilling again and is now at 4,650 ft.

• Fork Lick district, Webster County, the company's 1245 Pardee-Curtin Lumber Co. ran casing and cemented at 3,155 ft.

EASTERN KENTUCKY

On Beefhide Creek, Pike County, Lindsey & Elliott have completed 1 Joe Wright as a Mississippian Big lime producer. Well flowed initially at the rate of 6,000,000 cu. ft. of gas daily from a total depth of 2,382 ft.

ARKANSAS

Big Flow Reported At Moreland Well

Carter Oil Co. 1 Homer Eakin Unit, C SE NE SW 2-8n-19w, Moreland field gas well in Pope County, northwestern-central Askansas, flowed at the rate of 18,153 M.c.f. of gas per day from the Barton sand at 3,963-93 ft. The new well is 1 mile east of produc-

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tion in the field. Location is 10 miles northeast of Russellville, Ark. Age of the Barton is lower Pennsylvanian.

CALIFORNIA

Southeast Stenderup Offset Abandoned

Union Oil Co. missed with a southeast offset to its Stenderup discovery near Arvin in Kern County. The offset, 66-21 Union-Hancock, was abandoned at 9,765 ft. when it failed to find the zone. Union now has three producers in this play which was touched off last October. The discovery well flowed 1,170 bbl. daily from the upper Miocene sand at 9,535-9,717 ft.

Union was grading location for another wildcat in the area. This one will be drilled in SE SE 27-31s-29e, about 2 miles southeast from the Stenderup activity.

New Life for Old Field

Union Oil Co. has given new life to the 30-year old Rosecrans field in Los Angeles with two completions in a new shallow zone. Union took two small producers, 2 Padelford and 3 Chandler, on the northeast flank of the field and recompleted them in a new zone at 4,000 ft. for a total of 800 bbl. daily. This represents 25 per cent of the field's total production from more than 200 other wells completed in other zones between 5,000 and 8,000 ft.

Texaco Quits Huron Test

The Texas Co. abandoned as dry a 3,310 ft. wildcat in the Huron-Westhaven area of Kings County. This test, 1 Boston Ranch, was located about 1¾ miles southeast of a 14,724 ft. dry hole abandoned by General Petroleum Corp. in 1951. GP reported some shows in its deep test at the time but failed to get commercial production.

Monterey Releases Platform

Monterey Oil Co. has released Pacific Driller No. 1 from its core-hole evaluation project on a 1,280-acre lease offshore from Huntington Beach. A total of four core-holes were drilled, the last of which was taken to 7,900 ft. Monterey, as operator on the lease for itself, Humble Oil & Refining Co., and Seaboard Oil Co., has postponed indefinitely any further work on the lease. The platform has been towed to Standard Oil Co. of California and Humble's 5,500-acre offshore lease at Summerland where it will conduct another core-hole program.

CANADA

ALBERTA

Fourth Red Earth Well Is Success

Another producer for the Red Earth Creek area of northern Alberta was assured during the past week as Union Oil Co. of California's newest test to penetrate the Granite Wash gave up 2,800 ft. of clean oil on drill-stem test of that section. The new well, Union 2-4 Red Earth Creek, on LSD 2, 4-88-8w5, 4 miles north and 1½ miles east of the firm's initial discovery well, is the fourth venture in this area to open up an oil column in the discovery horizon. The initial follow-up well, 1 mile east of the strike was a success while a 1 mile north and ¼ mile east extension to it also proved productive. The most recent success is 2½ miles north and ¼ mile east of the closest previous producer.

Union's development at Red Earth lies 82 miles east-northeast of Peace River town and is 220 miles north of the city of Edmonton. All of the company's drilling in evaluation of this area has been carried out on Petroleum and Natural Gas Reservation No. 2349.

ROCKFORD

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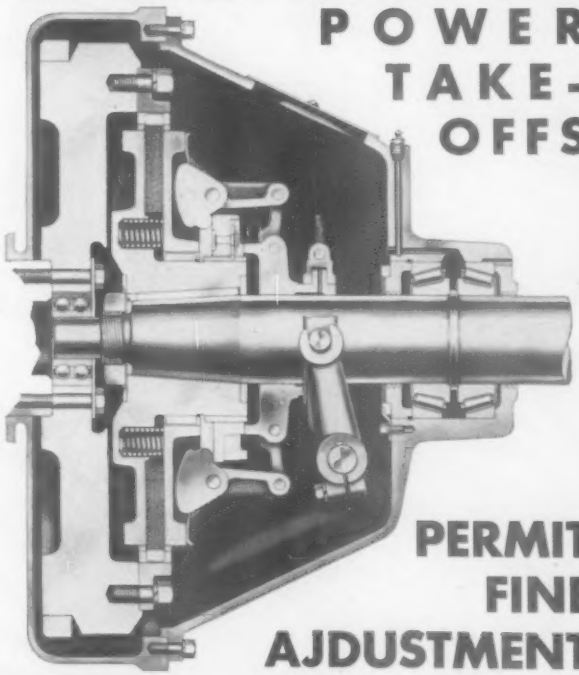

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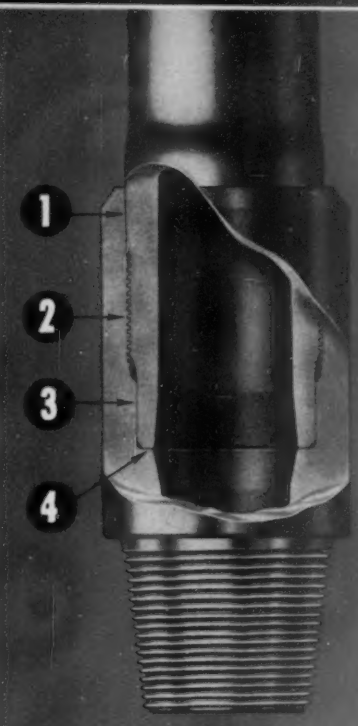

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OKLAHOMA CITY

This spread of 99,840 acres is only one of the firm's 14 reservations in the general area. The spread is contained in a block streching 28 miles south, 8 miles west, up to 20 miles east and as far as 78 miles north of the discovery well.

Production Tests Under Way at Whitecourt

Phillips Petroleum Co. of Oklahoma, another explorer in the Whitecourt area of northwestern Alberta is currently production testing an oil zone in the Mississippian formation which gave up a good recovery of crude oil during drill-stem tests operations run during the drilling of the venture. Phillips 1-B Pleasant, on LSD 6, 30-6-10w5, lies 9 miles northeast of Whitecourt townsite and is 85 miles northwest of Edmonton. Other drill-stem tests at the hole also indicated another two potential producing zones. These were defined at the Viking, where a moderate gas flow was encountered as well as a showing of oil, and the basal Blairmore, from which natural gas at rate up to 1,500 M.c.f. daily was recorded.

This well is locted 1¼ miles west and ¼ mile north of the firm's initial test in the area, 1-A Pleasant, which is capped as a potential Mississippian gas well.

QUEBEC

At 2 Bald Mountain well on the Gaspé Peninsula, just before readying the hole for shooting, the well tested 139,000 cu. ft. of gas per day.

The shot, when set, failed to go off, and another shot is being readied.

At 1 North Shore well, 1 2/10 miles south of Batiscan, 7-in. casing was cemented at 2,140 ft. and drilling is to be resumed next week.

At 2 North Shore well, 2 miles south of Berthier, the hole is down to 1,330 ft. and 8-in. casing is scheduled to be run, set and cemented soon.

At 3 North Shore well, 2 miles south of Portneuf, the hole is down to 945 ft. with untested gas showings encountered in the upper 500 ft.

KANSAS

SOUTHWEST KANSAS

Meade County Adds New Morrow Area

A new Morrow gas field was opened at Shamrock Oil & Gas Corp. 1 Collingwood, west-central Meade County, 3 miles southwest of Plains and 1½ miles southwest of Stevens field, NW NW NE 6-33-30.

The new producer flowed at the rate

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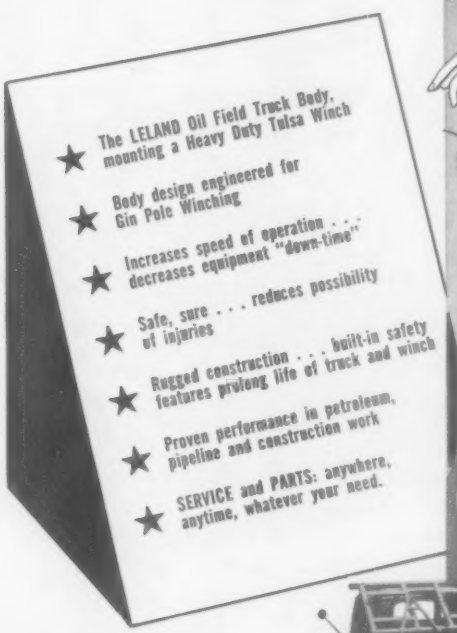
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LOUISIANA

LOUISIANA OFFSHORE

Dual-Pay Producer Opens East Cameron Area Field

Magnolia Petroleum Co., group operator, has a dually completed gas-condensate discovery well 3 miles off the Cameron Parish coast in Block 9, East Cameron area.

The well, on State Lease 1172, was drilled to 13,440 ft. Completion is from perforations at 13,056-13,120 ft. and 12,902-20 ft. The lower zone tested 3,300,000 cu. ft. of gas and 41 bbl. of 44.6°-gravity condensate per day, flowing through 5/32-in. choke. The upper pay made 3,100,000 cu. ft. of gas and 36 bbl. of 46.3°-gravity condensate, also through small choke.

Location is about 3 miles southeast of a 13,100-ft. gas-condensate discovery well completed in 1955 by Forest Oil Corp. in Block 4.

Associated with Magnolia in the new discovery are Natural Gas & Oil Corp. and Ocean Drilling & Exploration Co.

This is the seventh new-field discovery this year in the Gulf of Mexico off Louisiana.

SOUTH LOUISIANA

Deep Sand Produces in Darrow Extension Well

Production at Darrow, in Ascension Parish, is being stepped out 1 mile northeast in a deep discovery by Gulf Oil Corp.

The discovery well is the initial test on the company's D. J. Falcon and others unit. It is spotted in Lot 10, in 21-10s-2e.

Its flow during pre-potential tests through ⅝-in. choke was at the rate of 3,000,000 cu. ft. of gas per day. Gas sprayed 49.6°-gravity condensate. Volume was not gaged. Flowing pressure was 3,700 psi.

Pay is perforated at 10,554-88 ft. Total depth is 10,700 ft.

MICHIGAN

Mid-Salina dolomite oil pay, that has shown previously in another Dorr field well, was under test at Louis Zellman 4 B. Zellman, NW SE NE 25-4n-13w, Salem Township, Allegan County, and produced as much as 137 bbl. of net oil in 9 hours of intermittent test-

ing over 4-day period. Other flows showed for 30 bbl. net in 3 hours, 30 bbl. in 2 hours, 10 bbl. in 30 minutes on 2 half-hour tests. Casing pressure rocks to 1,150-1,200 psi., and well has in every instance on initial tests been shut in after it dropped to 750 or 800 psi. While no extended flow tests have as yet been run, well is estimated to be good for as much as 20 bbl. of clean, green 39°-gravity crude oil an hour.

Salinna oil porosity, which correlates with the so-called A-2 dolomite found in other areas, was perforated with 60 shots between 2,753 and 2,768 ft. after a bridge plug was cemented inside 4-in. liner at 2,800 ft. Well showed for about 2 bbl. of oil and from 45,000 to 70,000 cu. ft. of gas a day natural from this porosity. Considerable gas is showing since acid treatment and flow is actually a spray-flow and slug flow situation. It appears that well flows directly from pay zone once the 10-bbl. required to fill tubing has been produced. The 4 B. Zellman was the original Detroit River oil discovery producer in the Dorr pool.

One other Zellman test in the pool, 1 Helmer, SE NW NE 25-4n-13w, logged a comparable oil saturation zone in the Salina, but due to mechanical failures (inability to successfully shut off up-hole water), well was never adequately tested in this pay. It may be reworked providing an effective water shut-off it accomplished by squeeze-cementing.

This apparent success, if it continues to hold near present indicated levels, either as an oil producer or as a gas producer, may prompt deepening of many of the other Detroit River oil wells recently completed in the pool.

MISSISSIPPI

Paluxy Sand Produces in Jones County Discovery

Mississippi's spreading Lower Cretaceous exploration paid off the third time this year with a Paluxy discovery by Gulf Oil Corp. at its 1 Lee Welch et al Unit, in 9-9n-13w, 1½ miles south of Soso field, in northwestern Jones County.

The well's pay is perforated at 11,280-86 ft. Potential gage was 217 bbl. of 43°-gravity oil per day through 5/32-in. choke. Flowing pressure was 885 psi. on the tubing and 1,000 psi. on the casing side.

Hole had been drilled to 12,645 ft. in the lower part of the Trinity section. The Glen Rose-Rodessa and Sligo-Bailey sands, main productive zones of the prolific Soso field, failed to show oil or gas. Soso has one Paluxy well, as a gas producer shut in since completion.

Gulf's new discovery is 20 miles southeast of California Co.'s Bailey-sand oil-discovery well completed in January near Raleigh, in western Smith County. The year's second Lower Cretaceous discovery, made by Central Oil Co. in February, is about 10 miles west of California Co.'s well, in northeastern Simpson County. It also is productive from Bailey sand.

The new field has been designated as "Gitano."

NEW MEXICO

SOUTHEAST NEW MEXICO

Penn. Discovery Finaled In Western Lea County

Humble Oil & Refining Co. has completed its 1-AQ State as a Pennsylvanian discovery after several weeks of testing, to total depth 13,642 ft. in the Devonian. On potential test the well flowed 169 bbl. of 39.5° oil in 11½ hours through ⅜-in. choke, to rate a

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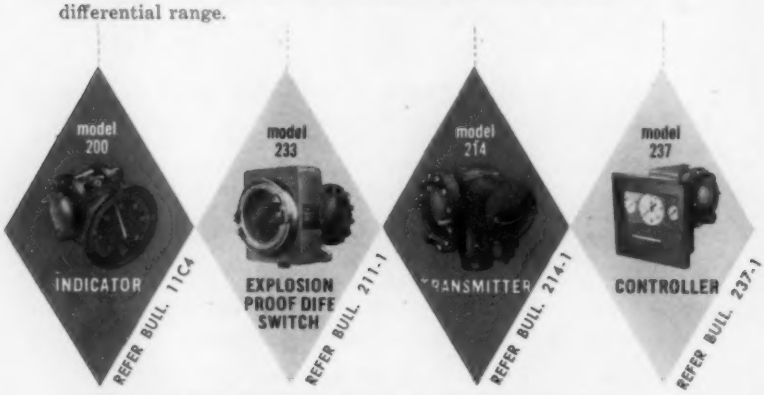

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daily potential of 350 bbl. Final perforations were between 10,960-84 ft. Flowing tubing pressure was 90 psi. and gas-oil ratio 1,732:1.

Location of the new well is in 3-16s-33e, about 3½ miles northwest of Sinclair's new Seaman-Pennsylvanian field, and 2 miles south of South Saunders field.

Ohio Oil Co. 1 State "SA," also in western Lea County, has opened Wolfcamp 1 mile northeast of the Kemnitz field Pennsylvanian discovery.

Ohio's well was drilled to 11,411 ft., then plugged back to 11,357 ft. Perforations in the Wolfcamp at 10,592-10,630 ft., after acid treatments, produced a flow of 18 bbl. of oil an hour through 18/64-in. choke, under tubing pressure of 675 psi. A drill-stem test in the Pennsylvanian at 11,270-11,361 ft. developed 20 ft. of oil and 50 ft. of heavily oil and gas-cut mud, plus the water blanket cut with oil.

Location is in SW NE 20-16s-34e, 2 miles east of Seaman field.

Skelly Well Completed As Pennsylvanian Discovery

Skelly Oil Co. 1 Sombrero Unit, 2 miles northwest of Seaman-Pennsylvanian field, has been completed as a flowing discovery from the Atoka sand section.

Daily potential was 305½ bbl. of 51° oil a day through ¾-in. choke, plus gas at the rate of 3,393 M.c.f. per day. Total depth was 13,700 ft. and final perforations were from 13,166-78 ft. Flowing tubing pressure was 250 psi. Top of the Atoka was 12,480 ft.

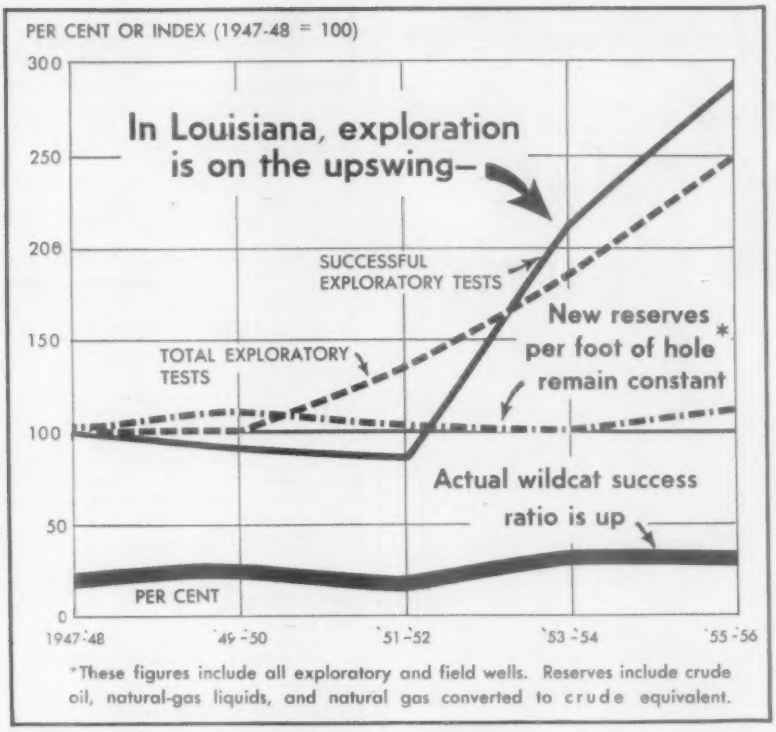
Location is SW NW 12-16s-33e, 17 miles west of Lovington.

Townsend-Devonian Area Gets Second Well

Sinclair Oil & Gas Co. and Shell Oil Co. have completed a second well in the new Townsend-Devonian field of Lea County, and have another in the testing stage.

The second producer for the field is 1 Nickson, north offset to the discovery, in SW NE 15-16s-35e. Potential was 480 bbl. of 62° oil a day, through ¾-in. choke on perforations at 12,542-12,620 ft. Gas-oil ratio was 499:1. Total depth was 12,691 ft., plugged back to 12,656 ft. Top of the Devonian was 12,367 ft.

The same operators' 1 Blackmon, SE SE 15-16s-35e, a southeast offset to the discovery, swabbed some oil from perforations at 12,740-50 ft., squeezed, and reperforated at 12,644-82 ft.



This chart shows exploratory results as . . .

Offshore Drilling Makes Louisiana Prime Target

● Success ratio double national average and future potential is excellent

by Norman S. Morrisey
Drilling-Development Editor

EXPLORATION in Louisiana really pays off. The exploratory success ratio is nearly double that of the national average, hovering at 30 per cent compared to a national average of 17 per cent.

What is more important, the new reserves added per foot of hole drilled are enormously high. It is the only state where the reserves per foot of hole has remained constant during the past 10 years. Nationwide, the figure is dropping at an alarming rate. In Louisiana, however, the industry is maintaining the pace set in 1947-48.

Actually most of the new reserves are concentrated in either South Louisiana or offshore. Drilling activity in North Louisiana and the results are not nearly so important. During 1965, for example, North Louisiana drilling slumped 369 wells under the 1955 total. South Louisiana and offshore activity was up 225 wells over 1955's activity.

The results of South Louisiana drilling became even more significant when studying new reserves. During 1956, there were 1,337 successful completions in South Louisiana, including both onshore and offshore wells. These wells added slightly over 1 billion barrels of new reserves or 756,000 bbl. of reserves per well. And the bulk of these reserves are either in South Louisiana or offshore.

Another excellent measure of South Louisiana's importance is the number of geophysical crews active. At last count, 100 crews were working the area, either in the swamp and bayou country or offshore. This is about 20 per cent of the total number of crews active in the United States.

What is the outlook? . . . Offshore will develop into a significant oil province, based on present results and what can be inferred from similar conditions on land. Atwater *(see The Oil and Gas Journal, February 11, 1957, page 96)* estimates that 20 per cent of the Grade A crude prospects offshore will become major oil fields with reserves of at least 100 million barrels of recoverable oil.

. . . Exploration results in the waters off South Louisiana have been sensational. Nearly 50 per cent of the exploratory tests have proved productive of either oil or gas. Offshore reserves should reach the 12 billion-barrel mark. Some 95 Grade A prospects have been mapped offshore.

Geologists now know that numerous exceptionally large structures exist in waters 600 ft. deep. It has been conclusively proved that these are salt domes. In time they will be either proved up or condemned by drilling.

. . . North Louisiana's oil and gas potential is by no means exhausted. Deep Smackover and Cotton Valley reserves are yet to be discovered. Stratigraphic thinking has uncovered a huge trap, the Crane trend that reaches from East Texas into North Louisiana a distance of 45 miles. Fracturing had a terrific impact on shallow drilling in Pine Island field for the past 3 years. The oil possibilities of the Tuscaloosa (Woodbine equivalent) have never been fully exploited.

. . . Onshore in South Louisiana, the chances for more new reserves are excellent. The old salt domes offer almost unlimited possibilities. Lake Washington is a good example of what can happen around these old domes. Discovered in 1930, first production was established in 1931 from a sand at 1,150 ft. During 1956 there were 66 wells completed on the flanks of the Lake Washington salt dome; production was from newly discovered Miocene pay sands at depths of 9,000-15,000 ft.

During 1956, approximately 70 per cent of all field drilling was on the flanks of known structures that had been discovered prior to World War II.

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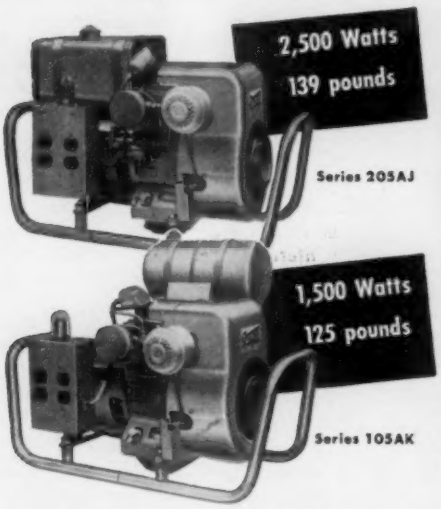

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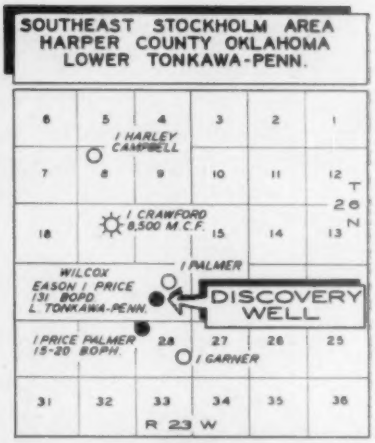


Section of Harper County, Northwest Oklahoma, where Wilcox Oil Co. and Eason Oil Co. are in the midst of an active development campaign following oil discovery at Southeast Stockholm.

OKLAHOMA

NORTHWEST OKLAHOMA

Extensive Campaign On In Stockholm Region

Three producers and three new drilling locations around the Southeast Stockholm field discovery well in Harper County make this one of the most active areas in northwestern Oklahoma.

Wilcox Oil Co. and Eason Oil Co. will drill the 1 Harley Campbell in C NE NW 8-26n-23w, the 1 Palmer in C SW NE 21, and the 1 Garnet in C NE SE 28.

Lower Tonkawa - Pennsylvanian oil production was tapped at 1 Price-Palmer in C NW NW 28-26n-23w. A drill-stem test at 5,534-79 ft. flowed an estimated 15-20 bbl. of oil per hour. Recovery was 5,350 ft. of 43°-gravity oil.

The 1 Crawford, C SW NE 17, 1½ miles northwest of the discovery well, flowed 8,500 M.c.f. of gas per day on tests at 5,423-60 ft. Recovery included distillate.

The discovery well of the field (see map) flowed 131 bbl. of oil per day from the Lower Tonkawa sand. This area is beginning to steal the show from booming Laverne district to the west.

SOUTHWEST OKLAHOMA

Bromide Tests Again Under Way At Knox

Testing is again under way at British-American Oil Producing Co.'s 1 Reed, new producing depth record well for Oklahoma, SW SW NE 20-3n-5w,

Knox field, Grady County. Perforations in the deep Ordovician-Bromide sands at 15,220-15,330 ft. and 15,575-15,645 ft. yielded 1,500 M.c.f. of gas per day and 265 bbl. condensate in 16 hours.

Good Well Added To Northwest Trimue Field

Northwest Trimue field in Tillman County, extreme eastern Palo Duro basin producing area in southwestern Oklahoma, added a good well. The new oil producer is Sun Oil Co. 1 Watson, NE NE SE 4-3s-19w. The Strawn-Pennsylvanian well flowed 392 bbl. in 14 hours on ¾-in. choke from perforations at 5,162-92 ft. There are 17 producers in this field.

S.E.G. Announces Scholarship Program

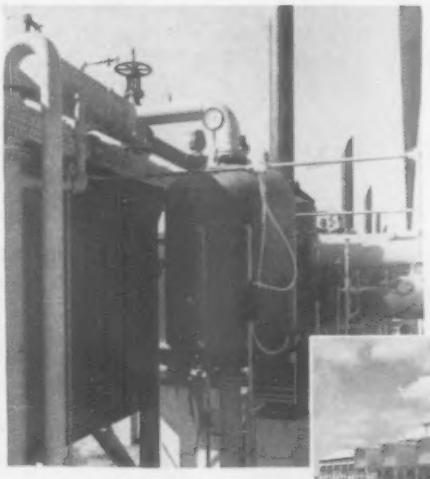
College scholarships in geophysics totalling more than $8,000 will be granted this year through the Society of Exploration Geophysicists it was announced by Roy F. Bennett, S.E.G. president and chief geophysicist for Sohio Petroleum Co., Oklahoma City. Bennett's announcement was released in Tulsa by W. M. Erdahl, president of the Geophysical Society of Tulsa, during the Engineers' Day luncheon honoring high school students and sponsored by the Oklahoma Society of Professional Engineers and the Engineers' Club of Tulsa. Erdhal is chief geophysicist for Skelly Oil Co.

Bennett said the nationwide S.E.G. program is supported by seven companies engaged in exploration geophysics and manufacturing, each sponsoring a scholarship in its own name. Selection of the recipients will be made by the S.E.G. student membership committee through impartial judging within restrictions set by the companies. However, Bennett said, each grant will bear the name of the company sponsoring it.

Grants will be made this year by Mayhew Supply Co., Inc., Griffin Tank & Welding Service and Geophysical Service, Inc., all of Dallas, Tex.; Herb J. Hawthorne, Inc.; Southwestern Industrial Electronics Co., and Vector Manufacturing Co., all of Houston, Tex.; and by Grant Body & Equipment Co., Tulsa. In addition to the individual grants, a general fund has now been started with a contribution of $100 from Exploration Consultants, Inc., of Tulsa.

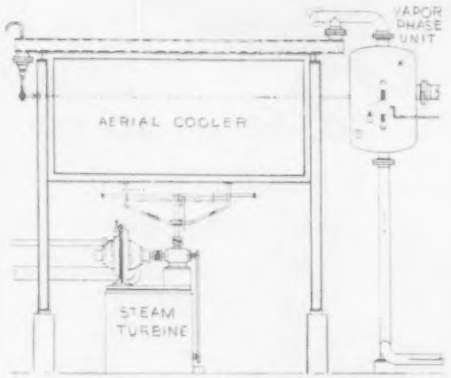
Bennett said companies interested in the program may contact Bart W. Sorge, chairman of the S.E.G. public relations committee. Sorge is vice pres-

UNITED GAS PIPE LINE CONVERTS TO VAPOR PHASE



Eliminates Engine Power for Driving Turbine Fan . . . Utilizes Power Cylinder Waste Heat

In January, 1954, United Gas Pipe Line Company installed Vapor Phase Thermal Circulation on five 880-bhp gas engine compressors at their Agua Dulce, Texas, gas compressor station.



During September, 1956, one fan-drive was converted to the Vapor Phase Steam Turbine Fan Drive (utilizing power cylinder waste heat as steam at 15 p.s.i.g. pressure), thus eliminating engine power formerly required to drive the fan for lube oil cooling and steam condensing.

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ident of United Geophysical Corp., Pasadena, Calif. Application forms may be obtained from S.E.C. headquarters, Box 1536, Tulsa 1, Okla.

ROCKY MOUNTAIN

NORTH DAKOTA

Beaver Lodge Deep Test Flows Ordovician Oil

Amerada Petroleum Corp.'s deep test on the Nesson anticline flowed 241 bbl. of condensate on a 16-hour test of the Red River-Ordovician at 12,810-46 ft., threatening the North Dakota producing-depth record.

The 1 Iverson-Nelson, NW SE NE 2-155n-96w, Beaver Lodge field, Williams County, recovered 8,140 M.c.f. of gas and 25 bbl. of water after acid treatment on this test. Prior to the acid the flow was 155 bbl. of oil and 21 bbl. water plus 6,489 M.c.f. of gas in 19 hours of testing. Amerada has shut in this deep discovery prospect.

From even deeper perforations at 12,846-76 ft. a 9-hour test got 5,531 M.c.f. of gas. The company has another pre-Cambrian wildcat drilling in Beaver Lodge field. It is the 9-A Unit, NW SE SW 16-156n-95w. Drilling is below 6,500 ft.

Ward Discovery Going on Pump

The first producing well in Ward County, Hanlon Drilling Co. and L. J. Williamson 1 Knudston, NE SE 7-157n-87w, 40 miles east of Nesson anticline production, will go on pump. Swabbing netted 100 bbl. of clean oil in 7 hours from the Mission Canyon at 6,734-95 ft. Location of this important discovery is 14 miles northeast of Palermo, N. D.

WYOMING

Confirmation Well at West Moorcroft Is Successful

The confirmation well to West Moorcroft field in Crook County was completed by Skelly Oil Co. for 165 bbl. of oil per day from the Newcastle (Muddy) sand at 4,140-57 ft. The well, 1 Goetzinger, C NE NE 1-51n-68w, confirms and is the south offset to Owanah Oil & Development Co.'s discovery well at 1 State in C SE NE 36-52n-68w. That well flowed 150 bbl. per day from perforations in the Muddy at 4,101-10 ft.

Cottonwood Creek South Stepout Well Completed

A south stepout to Cottonwood Creek field in Washakie County was completed for a pump gage of 471 bbl. of oil per day.

The well is L. E. Elliott 1 Elliott, C NW NE 26-47n-91w. This successful completion extends the field production 1¼ miles south. There has been no previous drilling in the area between the field and the new producer.

Location of this prolific field is 10 miles east of Worland, Wyo. It was discovered by Stanolind Oil & Gas Co. (now Pan American Petroleum Corp.) back in 1953 at the 1 Unit, C SW SW 2-47n-91w. The 2 years after field discovery saw extensive field development activity. Last year alone the field produced about 1,700,000 bbl. of oil.

Muddy Shows Reported At Diamond Ranch Wildcat

Recovery of 1,348 ft. of oil was reported at Ohio Oil Co.'s 2 Unit, NE NW NW 25-20n-78w, Diamond Ranch Unit, Carbon County. Pay is the Muddy, topped at 5,314 ft. The test was at 5,461-88 ft. Recovery included 90 ft. of oil and gas-cut mud. A previous

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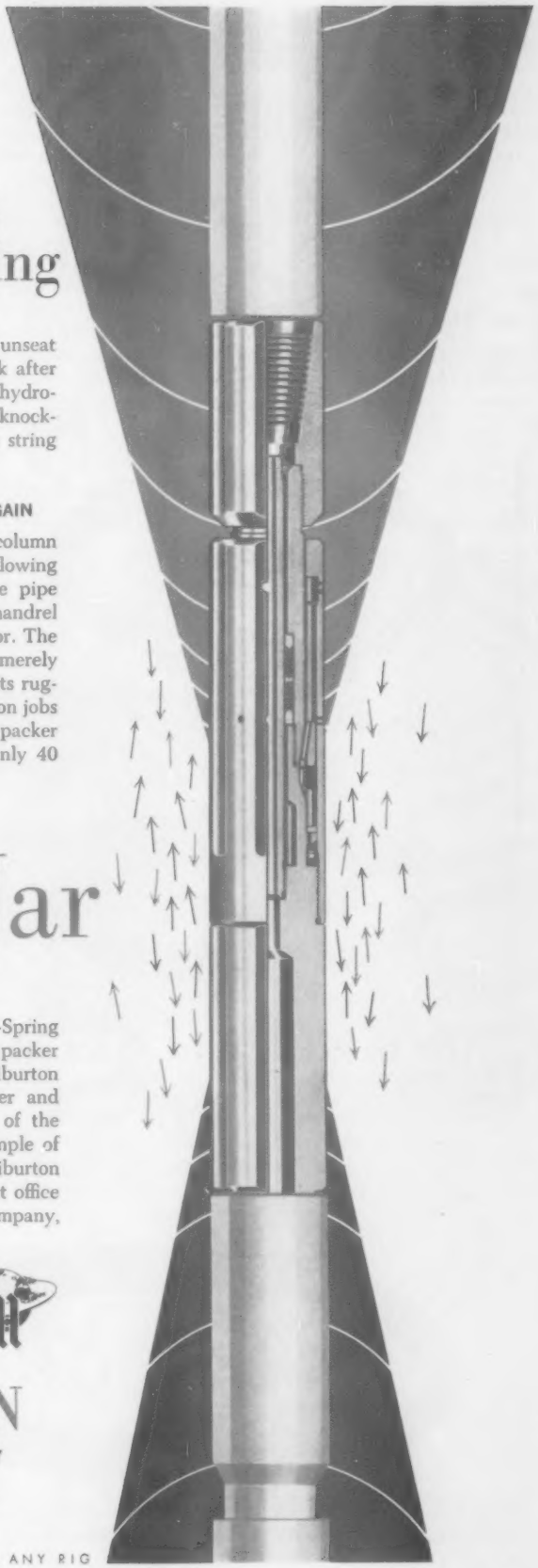

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Muddy test at 5,299-5,335 ft. got 60 ft. of clean oil, 30 ft. of mud-cut oil, and 90 ft. of drilling mud.

Successful completion of Ohio's well would offset Lakota production established at 1 Unit in SE SW 24-20n-78w, a 263-bbl. per day pumper from 5,377-5,426 ft. This new Muddy prospect would give the new area two pay zones from two wells.

UTAH

Paradox Report

The newest addition to the booming Paradox basin success campaign is Davis Oil Co.'s 1 Navajo-A, C NE NE 27-41s-24e, San Juan County.

This discovery flowed at the estimated rate of 30-45 bbl. of oil per hour on drill-stem test at 5,510-90 ft. in the Paradox-Pennsylvanian. Operator is running pipe.

This discovery well is 4½ miles southwest of Aneth proper, and is the Denver operator's first attempt in the basin.

● Mud was recovered on a drill-stem test of Pan American Petroleum Corp.'s 1 Featherstone in NW SW SW 24-40s-22e, 3 miles west of Recapture Creek at the western end of the Paradox play. The test was at 5,454-82 ft. A test at 5,402-54 ft. flowed oil at the estimated rate of 6 bbl. hourly. The area between this well and Recapture Creek has had no previous drilling. Success at Pan American's well would move Aneth trend production to its westernmost anchor.

● A second try in the temporarily abandoned Fish Creek area at the northwest corner of the Paradox fairway is under way. Texota Oil Co. is below 390 ft. at its 2 Utah-Federal "H," SE NE 14-38s-20e. The well is south of the 1 Utah-Federal "H," C NE NE 14-38s-20e. Texota was unsuccessful at this well which had shallow oil possibilities. Location of Fish Creek is 18 miles northwest of Bluff Unit and 14 miles southwest of Blanding, Utah.

● Gulf Oil Corp. quit at its White Mesa wildcat in C NE NE 27-42s with total depth of 6,457 ft. reported. There were shows of oil at this wildcat on cores and tests. Location is 5 miles south of Desert Creek and 7 miles east of North Boundary Butte field.

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COLORADO

Paradox Basin Tests Drilling in Montezuma

Several locations are active in extreme southwestern Colorado. Carter Oil Co. 1 Aztec-Government, a 6,300-ft. Paradox wildcat, is taking drill-stem tests at 5,060-5,100 ft. This Montezuma County wildcat is 17 miles west of McElmo field.

The California Co. is drilling south of Carter at 1 Ute Tribal in C NW NW 22-33n-19w, in the Mariana Springs area. Coring is below 7,181 ft. in the lower Hermosa-Pennsylvanian. El Paso Natural Gas Co. has a well drilling at 1 Mariana Wash, SW NW 30-33n-19w.

Paradox basin explorers are watching these tests with keen interest. The booming success across the line in southeastern Utah has yet to move into Colorado. The eastern anchor of the Aneth Trend is just west of the Colorado line. A move into southwestern Colorado has been anticipated. Success at any of these Montezuma wildcats will spark a fresh wave of enthusiasm in this little drilled section of the basin.

Oil Flows at Buck Peak Prospect

Malco Refineries 2 Kowach, C SE NW 25-6n-90w, flowed oil at the rate of 11 bbl. per hour on a 7-hour test of the Mancos. This Buck Peak area wildcat is located 7 miles southeast of Craig, Colo., in Moffat County. Production at the new discovery is from open hole.

The other well in this field, the discovery 1 Kowach, found oil in the Shinarump at 8,000 ft.

Drill-stem tests at the Mancos well were at 6,419-6,550, and 6,548-6,625 ft.

Las Animas Wildcat Flows Morrow Sand Gas

Testing is under way at D. D. Harrington's 1 Morse "A" discovery well in C SE NW 28-20s-48w, Kiowa County. This southeastern Colorado prospective new Morrow gas discovery is on the Las Animas arch. Gas flowed on tests of perforations at 4,728-40 ft. at the rate of 5,010 M.c.f. per day.

Location of this newest of additions to the Pennsylvanian gas and oil fields on the arch is about 3 miles southeast of McClave field.

Berthoud Area Muddy Discovery Completed

A small Muddy sand oil pool was opened at Lakota Petroleum Co. 1 Hale in C SW NE 6-4n-68w, 4 miles southeast of Berthoud in Weld County.

The discovery well flowed 10 bbl. of oil per day on ¼-in. choke from perforations at 5,438-66 ft.

Permian Wildcat Reported At Lincoln County Site

A rank 5,700-ft. Lyons sand (Permian) wildcat will be drilled by Murphy Corp. and Ashland Oil & Refining Co. at 1-6 Bennett in C NE NE 6-10s-55w, Lincoln County. There has been no pre-Cretaceous drilling in this area. The wildcat is 6 miles southeast of Limon, Colo.

NORTHEAST NEW MEXICO

Rank Wildcat Scheduled Near Clayton in Union

Continental Oil Co. will drill a 6,000-ft. granite exploratory test in Union County, just west of the Texas line in northeastern New Mexico's Clayton area. The 1-2 Federal Land Bank, C SE SE 2-25n-36e, is in an area of no previous drilling.

SAN JUAN BASIN

Gallup Pickup Seen In San Juan County

Two wells were staked last week near Anderson-Prichard Oil Corp.'s 1956 Gallup oil discovery in San Juan County. Sunray Mid-Continent Oil Co. will drill 1 Es-Ke-Del-E-Wood, W½ NE SE 22-25n-11w; The Texas Co. will drill the 1 Navajo "M," N½ SW NW 23-25n-11w.

This is the first activity around the Anderson-Prichard discovery since it was completed last year for 300 bbl. of oil per day from the Gallup sand.

Dakota Discovery Finaled In Rio Arriba County

A gas-distillate Dakota sand discovery well was completed by Skelly Oil Co. The 6 Jicarilla "C," SE NW SE 27-25n-5w, Rio Arriba County, flowed 60 bbl. of distillate and 1,569 M.c.f. of gas per day on ¼-in. choke from Dakota sand at 7,022-48 ft.

Another Dakota producer lies about 1 mile north at 1 Jicarilla "C," SW NE SE 22-25n-5w. That Skelly well was completed about 2 years ago for 9,500 M.c.f. of gas per day and 62 bbl. of distillate per million cubic feet of gas. Location of these two wells is in the South Blanco area. A third Dakota try, the 14 Jicarilla "C," SW NE NE 27-25n-5w, half way between the two Skelly successes, is waiting on orders at 5,015 ft., total depth. Some gas was reported at 4,881-4,965 ft.

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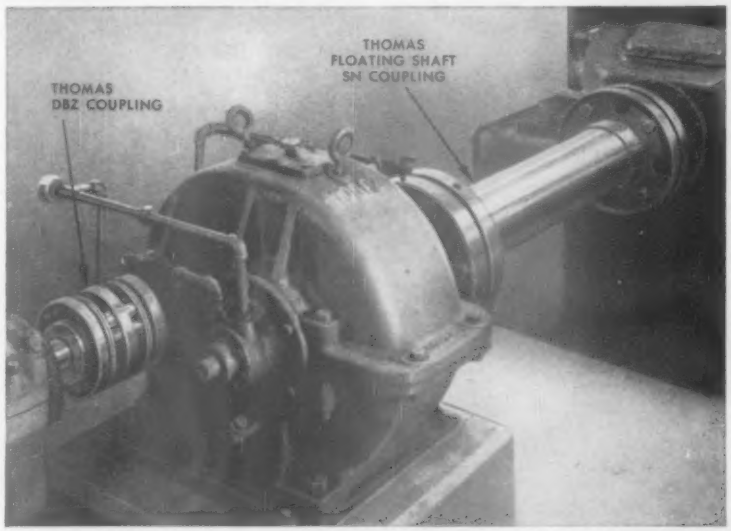

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Helicoid gages set new standards of enduring accuracy, trouble-free service, and economy

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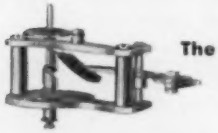
These gearless gages go on performing day in and day out with little or no maintenance. This economy, together with long life, adds up to the fact that HELICOID Gages cost less per gage per year than any other gage you can buy.

Gages for vacuum and compound service. Pressure ranges up to 20,000 psi.



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TEXAS

EAST TEXAS

Houston County Gets Prospect and Deep Start

Houston County oil news last week included one prospective Woodbine sand strike 12 miles northeast of Midway townsite, and two new wildcats, one of which was scheduled to 13,000 ft.

The new prospect is Midwest Oil Corp. 1 Dan P. Craddock. This well went into the Woodbine at 8,002 ft., minus 7,830 ft. A drill-stem test at 8,018-23 ft. recovered 95 ft. of high gravity distillate and a show of gas. Operators then ran casing to 8,872 ft.

A test on perforations at 8,380-91 ft., with packer set at 8,362 ft., produced a good blow throughout and recovered 90 ft. of heavily distillate-cut drilling mud, 270 ft. of heavily oil and gas-cut mud and 90 ft. of salt water. Flowing pressure reached 175 psi. maximum.

Location of the wildcat is 5 miles northwest of Woodbine production in Fort Trinidad field, and in John Durst Survey, A-29.

Deeper of the two Houston County wildcats is Humble Oil & Refining Co. 1 Southland Paper Mills, Inc., staked 11½ miles northwest of Trinity townsite in the old shallow Trinity field. Drill site is in W. D. Smith Survey.

The other wildcat is Oil Properties, Inc., Dallas, 1 Grover & Moseley, contracted to 6,300 ft. Location in J. I. Collins Survey is 4½ miles northeast of Grapeland.

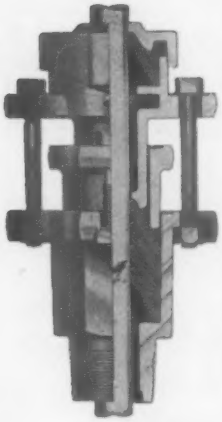
Franklin Smackover test . . . Humble Oil & Refining Co. has entered the New Hope area of Franklin County at its 1 M. C. Rhoades. Location is on a 72-acre lease in Jonas Bassey Survey, 9 miles northeast of Winnsboro, and about ½ mile northwest of Tidewater Oil Co. 1-D Rhoades. Tidewater's test drilled into the Smackover at 11,780 ft., and at last report was waiting on potential test.

NORTH TEXAS

Cambrian Sand Gaged At Stonewall County

Stonewall County's prospective Cambrian sand discovery has been completed from that formation for 403 bbl. of 41° oil a day.

The discovery is J. R. McLean and J. D. Tompkins 1-A Trammell, located in the Tompkins field in southern Stonewall County. Production from the Cambrian was through 16/64-in. choke, from perforations at 5,917-27 ft. Tub-



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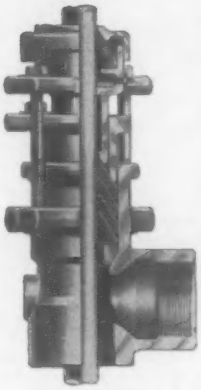

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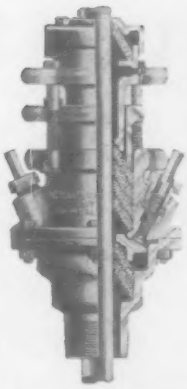
A combination Stuffing Box and Pumping Tee. Makes a short connection. Bolt lugs are placed low to eliminate fouling of elevator links. No bell nipple needed as top of body will support elevator. Full opening — unnecessary to remove body when pulling or running rods.



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* All HERCULES Stuffing Boxes may be equipped with Oil Reservoir Upper Glands on "problem" wells which pump-off and burn the packing. The polished rod moves through the oil in the reservoir which lubricates and cools it.

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ing pressure was 190 psi. and gas-oil ratio was 620:1.

Previously the well completed from the Ellenburger at 5,718-50 ft., making 204 bbl. of 40° oil on 16/64-in. choke. Location is 10 miles south of Aspermont, in Section 135, Block 1, H&TC Survey.

This is the second Cambrian well for Stonewall County. The first was completed in Schick field, north of Aspermont, but has since been depleted in that formation.

Tompkins field in southern Stonewall County gained its first Cambrian producer at a good flowing well. Nearest similar oil is 35 miles to the south in Nolan County's White Flat field.

Clay County Strike Is Dual Completion

Mississippian and lower Caddo oil has been opened 6½ miles west of Bellevue in Clay County at Bobby M. Burns 1-A Mayfield.

Location is on the southeastern flank of Lutz field, in J. T. Collingsworth Survey A-96.

Potential from the Mississippian was 201 bbl. of 44° oil a day through 8/64-in. choke, from perforations at 6,038-46 ft. Tubing pressure was 190 psi. and gas-oil ratio 677:1.

From the lower Caddo section at 5,812-40 ft., the well flowed 132 bbl. of 44° oil a day on 10/64-in. choke. Casing pressure was 420 psi. and gas-oil ratio 607:1.

Requested new-field name is Mayfield (Mississippian and lower Caddo).

Knox County prospect . . . Smith & Breyer 1 Joe Davis, located 4 miles northeast of Knox City, flowed oil while drill-stem testing the Tannehill sand at 2,083-92 ft. Oil reached the surface in 90 minutes, and for 15 minutes flowed at the rate of 10-12 bbl. an hour. Fluid in the pipe was reversed out, being 1,125 ft. of oil, 90 ft. of oil and gas-cut mud and 206 ft. of oil and mud-cut water. Bottom-hole flowing pressure was 615 psi. Operators drilled

ahead to 2,150 ft. and set pipe for completion tests.

Location is 1 mile east of new production. Operators have requested Griffin as the new pool name.

SOUTHWEST TEXAS

Gasser Completed In Sweden-Benavides Gap

A 22,000,000-cu. ft. wet-gas well has been completed in a Pettus-sand discovery by Oil Corp. 6 miles south of Benavides, in southeastern Duval County. Liquid (65.8°-gravity condensate) recovery averages 27 bbl. per 1,000,000 cu. ft. Pay is perforated at 5,788-98 ft.

The well, 1 Atlee Parr, in Block 10, Wheeler-Splance Subdivision, is in the narrow gap between Sweden and Benavides field. It is north of the northeast tip of the former, and south of the southeast tip of the latter. Sweden produces from Government Wells (Jackson) sand, and Benavides from Cole and Yegua sands.

WEST TEXAS

Crane County Wildcat Flows Pennsylvanian Oil

Gulf Oil Corp. 1 Adams, deep test in the Dune field of northeastern Crane County, reported a flow of oil while drill-stem testing in the Pennsylvanian. Production in the Dune areas is from the San Andres at 3,400 ft. to the Cisco limestone (Pennsylvanian) at 8,400 ft.

Gulf's well ran a 7½-hour test from 7,680-7,750 ft. Gas surfaced in 8 minutes and fluid in 20 minutes. After cleaning to pits for 15 minutes, the well flowed 435 bbl. of 40° oil in 7 hours. Bottom-hole flowing pressure was 2,630 psi., and 15-minute shut in pressure reached 3,365 psi. During the oil flow, the first hour gage was 41.4 bbl., and 66.24 bbl. on the seventh hour. Operators drilled ahead for a test at 7,750-80 ft. The well is an Ellenburger test.

Bakke Field Extension Gets New Pay Zone

Bakke multi-pay field in central Andrews County was in line for a new and higher pay zone in the Pennsylvanian.

The well is Woodley Petroleum Co. 2-G J. E. Parker, in 27-A44-PSL Survey. Location is ⅞ mile southeast of nearest Pennsylvanian production and 4½ miles southeast of Andrews.

On a partial test at 8,775-8,805 ft., recovery included 60 ft. of oil. A test at 8,820-57 ft. had gas in 7 minutes and drill pipe unloaded after the tool was closed. A full string of oil was reversed out, with no water. Flowing pressure was 235-915 psi., and 30-minute shut-in pressure read 3,225 psi. Operators drilled ahead on an Ellenburger contract, to 12,300 ft.

A dual Ellenburger and Devonian well has extended production to the north and west of Bakke field at Woodley Petroleum 1-H Parker, 21-A44-PSL. Combined flowing potential was 1,261 bbl.

Ellenburger potential was 456 bbl. a day through 24/64-in. choke, from perforations at 12,300-25 ft. Tubing pressure was 700 psi. Devonian potential was 805.8 bbl. through 16/64-in. choke, from perforations at 10,456,85 ft., under casing pressure of 1,080 psi.

TEXAS GULF COAST

Deeper Sand Uncovered At North Willow Slough

Kilroy Co.'s new Nodosaria discovery well in the North Willow Slough area, in eastern Chambers County, is rated good for more than 60,000,000 cu. ft. of gas per day with liquid recovery in the ratio of 23,530 cu. ft. gas per bbl. Liquid is a 58°-gravity condensate.

Productive zone is perforated at 9,525-29 ft. This is about 1,200 ft. below previous deepest production in the field. Total depth is 9,751 ft.

The well is in Section 93, H&TC

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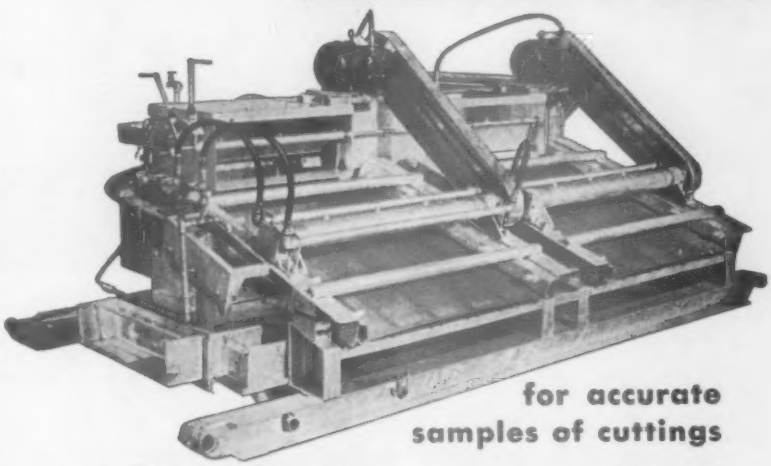
DOUBLE VIBRATING SHALE SHAKER...and SAMPLE MACHINE



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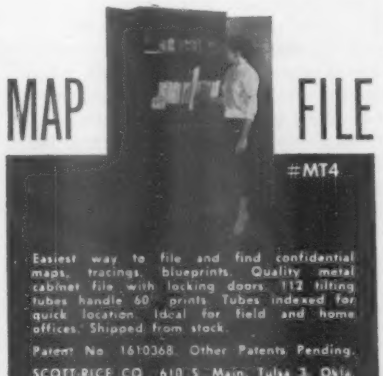

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Survey, about 4 miles southwest of Fig Ridge.

North Collegeport Grows

Tidewater Oil Co. has completed another good producer in its new North Collegeport field, in southwestern Matagorda County. It is the fourth for the company in the field, and the third for the Frio C-2 sand. The well, 1 Baker, flowed 272 bbl. of 33.7°-gravity oil per day through 5/32-in. choke. Its Frio C-2 sand is perforated at 8,182-86 ft.

Successful Wildcats

CALIFORNIA

Ventura County: Piru Creek Venture Co. No. 2 Reichenbach, SE NW 21-5n-18w, 30 BOPD, 31° gravity, perfs. 945-1,035 ft., TD 1,700. (New field discovery near Piru.)

Kern County: Superior Oil Co. 44-33 Wesco-Clark, SE NW 33-29s-26e, 98 BOPD, 33.7° gravity, 8/64-in. choke, perfs. 7,698-7,720 ft., TD 9,675 ft. (New field discovery ½-mile north of abandoned McClung field.)

Richfield Oil Corp. 16-30 Richfield-Mohawk-Wheeler Ridge Community, NW SW 30-11n-19w, 594 BOPD, 56.8° gravity, 29/64-in. choke, perfs. 7,976-8,103 ft., TD 9,777 ft. (New JV sand pool discovery in well originally completed September 22, 1956 as a noncommercial Pulv sand discovery at 8,948-9,042 ft.)

Kings County: Franco Western Oil Co. 41B-33 Norris-Orchard, 57 BOPD, 46° gravity, 6/64-in. choke, perfs. 2,750-93 ft., TD 5,200 ft. (New pool discovery in Pyramid Hills field.)

COLORADO

Weld County: Lakota Petroleum Co. 1 Hale, C SW NE 6-4n-68w, IPF 10 BOPD, Muddy discovery, new field. TD 5,767 ft. Lakota.

KANSAS

Barber County: Aylward Drilling Co. 1 Walker, SE SE NE 21-30s-15w. IPF 227 BOPD, 36.4°, Viola 4,557-62 ft. TD 4,751 ft. Opens East Turkey Creek pool.

Wm. Gruenerwald 1 Hirsch, C NW SW 20-34s-14w. IP 3,300 M.c.f. of gas per day, Mississippian 4,742-54 ft. TD 4,805 ft.

Butler County: Saco Oil Co. 1 Wiebe, 6-24s-6e. IPP 25 BOPD, 50 per cent water, 40°. Miss. 2,443-60 ft. TD 2,460 ft.

Cowley County: Wrido Drilling Co. 1 Dunn, NW NW SE 3-35s-5e. IPP 15 BOPD, 15 BW, 40°. Miss. 3,136-40 ft. TD 3,183 ft.

Decatur County: Joe Rothmeier 1 Kilzer, SE SE NE 2-1s-27w. IPP 57 BOPD, 28°, Lansing-Kansas City 3,465-72 ft. TD 3,500 ft. Opens North Warner pool.

Ellis County: CRA and J. B. Hawly 1 Johnson "Z," SE SW SW 32-11s-18w. IPP 70 BOPD, 29°, Lansing-Kansas City, 3,367-72 ft. TD 3,639 ft. Opens South Riverview field.

R. W. Shields 1 Homburg, NW NE NW 9-12s-20w. IPP 137 BOPD, 36° gravity. Marmaton 3,910-18 ft. TD 4,010 ft. New pay in Northwest Sweet William pool.

Graham County: L. J. Dreiling 1 Higer, SW SW NW 20-8s-23w. IPP 41 BOPD, 13

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per cent water, 40°, Lansing-Kansas City 3,710-14 ft. TD 3,760 ft. Opens Higer pool.

Imperial Oil Co. 1 Robinson, NW NW SE 17-9s-23w. IPP 1,727 BOPD, 38°, Lansing-Kansas City 3,826-30 ft. TD 3,895 ft. Opens Northwest Evergreen pool.

Russell County: A. F. Schmitt 1 McKune, NE SE SW 17-13s-15w. IPP 60 BOPD, 28°, Lansing 3,004-3,194 ft. TD 3,275 ft. Opens Kune pool.

Stafford County: Hilton Drilling Co. 2 Stroebel, SW NW SW 33-21s-14w. IPP 198 BOPD, 38°, Viola 3,744-49 ft. TD 4,905 ft. New pay in Radium Townsite pool.

Rawlins County: Miami Operating Co. 1 Fred W. Brumm "A," NE SE SW 7-2s-36w. IPP 30 BOPD, 32°, Topeka 4,170-85 ft. TD 5,200 ft. Opens Brumm pool.

Woodson County: George R. Jones et al, 1 Newby, NW NW SE 32-23s-16e. IP 1,000 M.c.f. of gas per day, Squirrel sand 1,094-99 ft. TD 1,496 ft.

KENTUCKY

Hopkins County: Felmont Oil Corp. et al 1 Word, 7-K-25. IPP 150 BOPD, 13 BW, Aux Vases 2,947-55 ft. TD 3,134 ft. Opens South Hanson pool.

Muhlenberg County: Wilson Petroleum Co. 1 W. E. Oates, 25-J-27. IPP 120 BOPD, 4 BW, McClosky 2,100-09 ft. TD 2,186 ft. Opens East Harps Hill pool.

MISSISSIPPI

Jones County: Gulf Oil Corp. 1 Lee Welch et al Unit, 9-9n-13w. IP 217 BOPD, 13/64-in., 43°, GOR 200 cu. ft. per barrel, perfs. 11,280-86 ft. (Paluxy). TD 12,645 ft. Elev. 266 ft., Lower Cretaceous 8,545 ft., Paluxy 9,783 ft., Mooringsport 11,535 ft., base of anhydrite 11,805 ft., first Rodessa sand 11,870 ft., Bailey sand 12,470 ft. (New field—Gitano.)

NEBRASKA

Shell Oil Co. 1 Hascall, C SW NE 6-18n-52w. IPP 182 BOPD, "J" sand discovery, new field. TD 5,029 ft. "J" sand.

PENNSYLVANIA

Indiana County, Armstrong Township: T. W. Phillips Gas & Oil Co. 1 A. W. Robinson 6,115,000 cu. ft. gas, Onondaga 7,390 ft., chert 7,402 ft., Oriskany sand 7,532-7,555 ft. gas in this sand. TD 7,565 ft.

SOUTHEAST NEW MEXICO

Eddy County: Western Ventures, Inc. 1 Spencer 4-16s-30e. IP 204 BOPD, 1-in., TP 20 psi., GOR 400, 36°, San Andres 2,804-44 ft. TD 2,844 ft.

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This chart gives average crude prices →

Old Drilling Logs Provide Data for Evaluation

HOW much faith can we place in oil shows logged by drillers in the old areas of the Mid-Continent? Fracturing has made it profitable to reevaluate these old logs, but often the data are misleading. This is particularly true with regard to oil shows. Did the operator actually plug a well that made 5-10 bbl. a day?

Henry Hobart, geologist with Kewanee Oil Co., Tulsa, has come up with one method of evaluating these shows. His curve (see chart page 261) gives the average price of Mid-Continent crude from 1911 to the present. Here's how he uses it:

Let's say a dry hole was drilled in 1915 and the driller's log records an oil show at 1,000 ft. in the Prue sand. This sand made an estimated 5-10 bbl. a day. At that time, the price of crude was 40 cents a barrel. The chances are excellent that the well report is reliable since it would have been uneconomic to have produced the well.

However, suppose the well had been drilled in 1920 when the price of crude was $3.50 a barrel. The report is probably unreliable *since* the operator would have completed the well as a producer. Similarly, in the 1930's the price of crude was below $1 per barrel. At that time, a 5-bbl. a day well was probably uneconomic; the same well in 1925 could have been completed as a producer.

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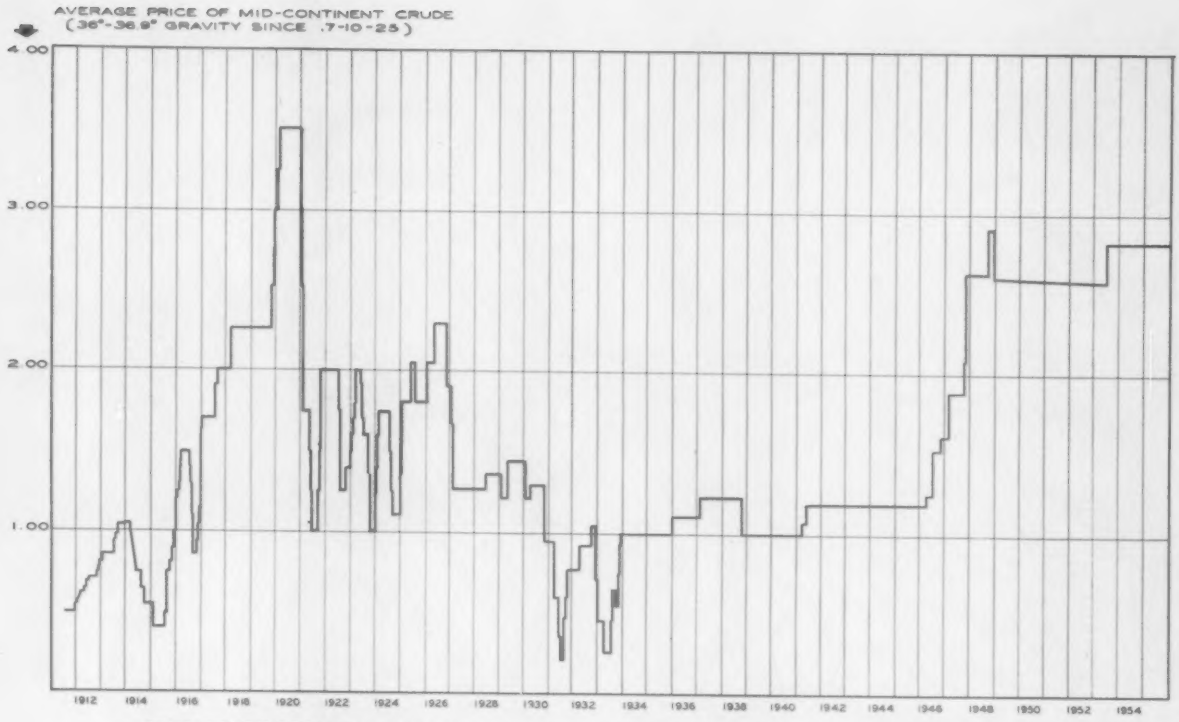
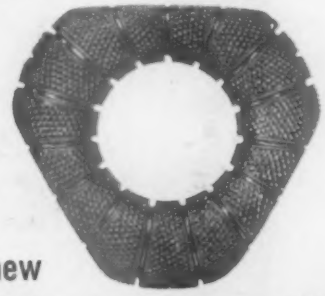


THIS GRAPH PERMITS GEOLOGISTS to evaluate accurately oil shows reported on old drillers' logs.

announcing . . .



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THE OIL AND GAS JOURNAL

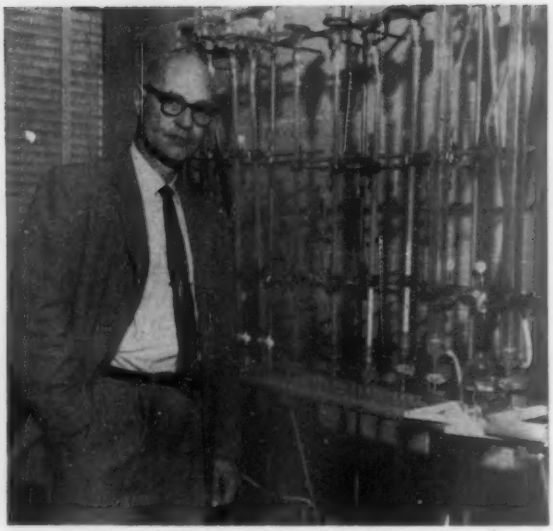
"Pardon me again, Ed—I was sure it was in this file."

Study of Source Beds Gives Accurate Potential

SHELL DEVELOPMENT Co. scientists have recently completed a study of oil basins throughout the world. They found that certain beds can be considered as the source of the oil that is now being or has been produced. In these beds, the amount of crude oil or hydrocarbons is substantially higher than the amount of crude in the surrounding rocks. These source beds are usually shales, marls, and argillaceous limestones. They may contain as much as 120 bbl. of hydrocarbons per acre-foot.

The hydrocarbons or crude oil actually form within the source bed. Subsequently, the oil migrated into the reservoir. Even after the oil has migrated, the source beds retain an appreciable amount of hydrocarbons. The migrated oil represents only a small portion of the total oil originally contained in the source bed.

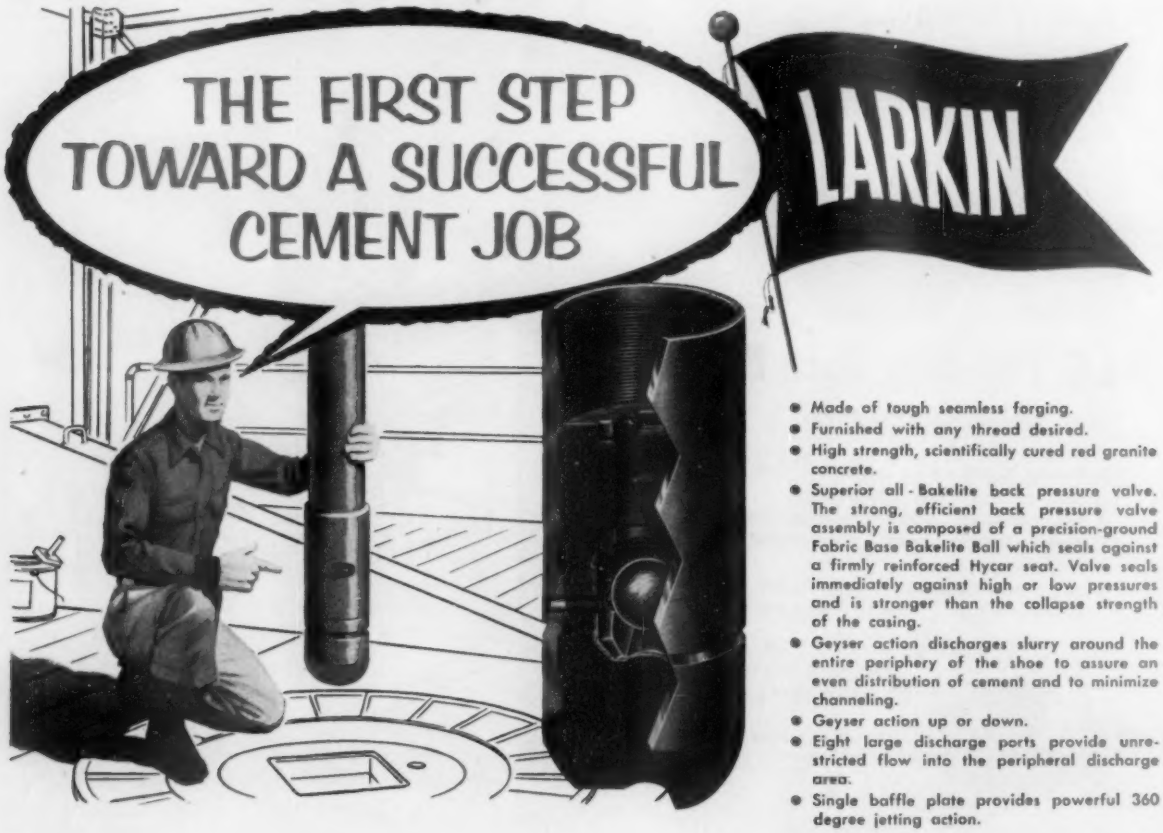
Results of study . . . G. T. Phillipi, senior research geologist, Shell Development Co., Houston, will present the results in St. Louis, April 1-4.



G. T. PHILLIPS, senior research geologist, Shell Development Co., Houston, checks laboratory equipment used to measure the quality of source rocks. This new technique enables geologists to appraise a new area's oil potential.

Shell scientists conclude that in many cases the amount of hydrocarbons now present in the source bed is of the same order of magnitude as the original hydrocarbon content. Thus the present hydrocarbon content is a reliable measure of the quality of the source rock or its ability to generate crude oil.

What does this mean? Basically, it means that scientists can now evaluate accurately an unexplored area by analyzing the potential source rocks. If there are high-quality source rocks present in the new area, the chances are good for oil production. By the same token, if the area rates poorly in source rocks, the chances are slim for finding large quantities of commercial oil.



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How Long Does it Take To Form Crude Oil?

DR. ALBERT L. KIDWELL checks a core during field test in Pedernales, Venezuela. Kidwell's work in Venezuela indicates that crude oil can form rapidly in nature, even before the sediments harden into rocks.

A CARTER OIL CO. scientist, Dr. Albert L. Kidwell, proves that oil forms quite rapidly. Even most recent rocks can contain measurable amounts of oil.

Geologists have long been bothered by the question, "Does it take a long time to form crude oil or not?" And by a long time, geologists are thinking in terms of millions of years. Dr. Kidwell, Tulsa, has an answer to this problem.

He says that oil can form quite early in the history of an area, and by geological standards, oil can form fairly rapidly. He has proved that some recent sediments (less than 5,000 years old) contain measurable amounts of crude oil or other hydrocarbons.

Dr. Kidwell is research group leader in geochemistry at Carter's research laboratory in Tulsa. He recently completed a detailed study of some sediments in northeastern Venezuela. One lenticular sand at a depth of 115 ft. contained three times as much hydrocarbons as the adjacent muds and sheet sands.

Analysis of the radioactive material in this sand showed the sand to be only 5,000 years old.

Kidwell's work shows conclusively that oil pools can start to form long before the sediments harden into rocks. The results of his work will be presented at the annual convention of the American Association of Petroleum Geologists, April 1-4, St. Louis. Field work for the project required 3 months in Venezuela collecting rock samples.

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Independent changes role as . . .

. . . Dean Has Key Job With T.G.T.

WHEN Tennessee Production Co. bought out Del Rey Petroleum Co. in 1952, Del Rey's principal owner, R. R. Dean, went along to help get things lined up a bit.

Since then, T.P.C. has been absorbed by the parent Tennessee Gas Transmission Co.—and so has Rudy Dean. He recently was named a senior vice president of T.G.T.

The transition from an independent operator to a major corporate executive is a strange road to travel, but that's the way Dean got where he is today.

As president of Bay Petroleum Corp., a T.G.T. subsidiary, and senior vice president of T.G.T. in charge of manufacturing and marketing, Dean is responsible for operations of all processing plants, the marketing of liquid and refined products, and crude-oil sales of T.G.T.'s substantial production department.

Dean also is a vice president of Tennessee Products Pipeline Co., which operates a 240-mile, 6-in. line between Agua Dulce in South Texas and the Houston Ship Channel. The line moves raw gasoline-plant products to a new fractionation plant built by T.G.T. The plant provides feed stock for Petro-Tex Chemical Co.'s butadiene plant. Dean also is a director of Petro-Tex, which is owned 50-50 by T.G.T. and Food Machinery & Chemical Corp.

Other processing plants operated by T.G.T. and affiliates are Bay's two refineries, a 24,000-bbl. plant at Chalmette, La., and a 10,500-bbl. plant at Denver; a gasoline plant at Eagle Lake, Tex., and one near Banquete, Tex., each with a capacity to process 100 million cubic feet of gas daily; and a small gasoline plant near Wichita Falls.

R. R. DEAN
. . . an eye out for youth.

Started when 13 . . . Dean, who'll be 58 this spring, is an old-timer in the business. At the age of 13 he got his first job: carrying water for a pipeline gang. He graduated from this into a job as lease pumper and learned to wrestle with the old-time steam engines used to drive the pumps. Firing the boilers before 6 a.m. every morning is a long cry from the present-day pushbutton leases, he agrees. At 17 he worked as an engineer in one of the first casinghead-gasoline plants in the business.

Dean went to Carnegie Tech, took some time out to serve as an airplane pilot in World War I, and then took a fling as an independent operator—and went broke. He joined Waite Phillips Co. as a roustabout in 1921 and became chief engineer in charge of pipelines and the company gasoline plant in 1924.

He left Phillips about this time and was on his own again until 1952, with the exception of a short stint as supervisor of gasoline plants for the Independent Oil & Gas Co.

At the time he left Phillips, Dean latched on to the name, "Del Rey," which he was to use in several oil-patch ventures. The name came about when he and a partner asked a Bartlesville, Okla., newspaper man to think up a name for their little marketing company which they set up in 1926. The newsman came up with Del Rey Oil Co. He also coined the slogan, "Choicest product of the refiner's art: motor oils and gasoline." Dean says their choicest gasoline was a mixture of casinghead and naphtha.

Del Rey Oil Co. was sold. It was followed by Del Rey Gasoline Co., organized during the depression. It was sold. So was the Del Rey Production Co. (to Continental Oil Co.). And finally, Del Rey Petroleum Co. went to T.G.T.

Outlook on work . . . Perhaps the thing he likes best about his present position is the confidence placed in him to do his job. An old believer in delegation of authority, he passes this confidence on down the line to "his boys."

He feels the best he can do for T.G.T. is to build up a comparatively young staff to take over one of these days. And he's been on a continuous search for such people.

The greatest thing he's learned is that sincerity of purpose and integrity mean more and more as time goes by. Dean says adherence to these principles may cause a man to miss out on a few deals; but in the long run, as a respected member of the oil fraternity, the principles will help him achieve success.

Earl C. Norris, spread superintendent with Houston Contracting Co., has been promoted to general superintendent of field operations.

Ralph O. Dietler, Tulsa consultant and former president and chairman of the board of Indiana Oil Purchasing Co. (Stanolind Oil Purchasing Co.), has bought an interest in Frisbie Drilling Co. of Tulsa. **W. S. Frisbie** is president of the company.

E. W. UNRUH

Earl W. Unruh, vice president of operations for Sinclair Pipe Line Co., has been advanced to president and chairman of the executive committee. He succeeds **William H. Morris,** who was recently elected a vice president of the parent company, Sinclair Oil Corp. Unruh has been with Sinclair since 1938. He was chief engineer before becoming vice president of operations in 1956. **Roy J. Tibbets,** chairman of the board, has retired. Tibbets has been with Sinclair and its predecessor companies since 1915. He was president of Sinclair Pipe Line before becoming board chairman in 1953. **G. M. Johnson,** vice president in charge of crude-oil lines for the company, has been appointed operations vice president succeeding Unruh. **J. D. McConnell,** director of engineering, will replace Johnson.

Carroll V. Kroeger, assistant chief design engineer for Washington Natural Gas Co., has been promoted to distribution engineer in Seattle. Kroeger joined Washington Natural a year ago.

Gaylord Elected President of Los Angeles Nomads

New officers of the Los Angeles Chapter of Nomads gathered at their eighteenth annual inaugural ball recently. They are, left to right, front row: Ben A. Hilliard, Web Wilson Oil Tools, Inc., treasurer; William C. Brooks, Byron Jackson Tools, Inc., vice president; Robert P. Gaylord, Wagner-Morehouse, Inc., president; Tom G. Martin, R. J. Eiche & Associates, secretary; W. B. Reinhold, Abegg & Reinhold Co., assistant treasurer; and Harry E. Hester, McCullough Tool Co., junior regent. In the back row, left to right, are: H. J. Schlarb, Continental-Emsco Co., senior regent; Earl M. Daniels, Hydril Co., sergeant-at-arms; Tom R. Ashe, Globe Oil Tools Co., deputy sergeant-at-arms; William Anderson, Pacific Perforating Co., assistant secretary; John H. Flanagan, Johnston Testers, Inc., master of ceremonies.

Gordon Flack has joined Platte Pipe Line Co. in Kansas City as a junior engineer.

James G. Corbett, formerly with Houston Oil Co., has joined the petroleum department of Texas National Bank of Houston.

Bob Estes, driller with Novak Drilling Co., Inc., in Tulsa, has been promoted to tool pusher.

Daniel R. Stewart, with Reading & Bates Drilling Co. in Edmonton, has been transferred to Lake Charles, La., as tool pusher.

Byron L. Plumley, petroleum engineer with Sinclair Oil & Gas Co., has been transferred to Casper, Wyo., from Bairoil, Wyo.

R. P. Medlin has been named a chief process engineer in the technical department of Magnolia Petroleum Co.'s Beaumont refinery. He replaces **B. J. Schultz,** who earlier this year was named coordinator of lubricants and allied products on the headquarters staff of Socony Mobil Oil Co., Inc., laboratories in New York. **E. J. Reeves,** assistant chief process engineer in the technical department's plant-testing section, has been promoted to replace Medlin as assistant chief process engineer in charge of planning and coordinating. **R. A. Bowden** has been shifted from assistant chief process engineer in the process-control laboratory to fill Reeves' former position.

Anthony V. Messineo, log analyst with Atlantic Refining Co. in Dallas, has been promoted to regional electric log analyst and transferred to Tulsa.

Edwin N. Kasper, Jr., geologist with **F. Julius Fohs** in Houston, has joined Trice Production Co. in Houston as geologist.

Seth L. Lobdell, junior geologist with Sun Oil Co. in Dallas, has been promoted to geologist and transferred to Abilene, Tex.

R. L. Harris, petroleum engineer with Sinclair Canada Oil Co. at Calgary, has joined Northern Natural Gas Producing Co. as production engineer in the company's Calgary district.

Don F. Tankersley, petroleum engineer with Anderson-Prichard Oil Corp. in Midland, Tex., has joined Sohio Petroleum Co. as engineer in Casper, Wyo.

Kenneth W. Richardson, regional engineer in Glenarm, Ill., for Panhandle Eastern Pipe Line Co., has been named regional engineer in Liberal, Kans., replacing **Leslie E. Goodwin,** now assistant purchasing agent of the Liberal area. **Billy J. Delap,** production engineer with the company, will replace Richardson in Glenarm. **Wilbur D. Dickey,** assistant superintendent at Glenarm, was recently transferred to Hugoton, Kans., in the same capacity. He replaced **E. J. Sims,** transferred to Paola, Kans.

Personals

John W. Newton, vice president and general manager of Magnolia Petroleum Co.'s refining division, will retire May 1.

Fred H. Plitt, formerly with Carter Oil Co. in Seminole, Okla., has joined Southwest Gas Producing Co. as staff engineer in Monroe, La.

Vance Porter, division reservoir engineer with Shell Oil Co., has been transferred to Kilgore, Tex., from Casper, Wyo.

W. H. Ward, reservoir engineer with Sohio Petroleum Co., has been transferred to Oklahoma City from Lafayette, La.

A. S. Gilles has been appointed administrative assistant to **W. A. Alexander,** Shell Oil Co.'s vice president in the Denver area. **A. A. McLeod,** Midland, Tex., will replace Gilles as personnel and industrial relations manager in Denver.

St. George Creaghe, design engineer with Phillips Chemical Co. in Pasadena, Tex., has been transferred to Phillips Pacific Chemical Co. as maintenance engineer at the company's new Kennewick, Wash., plant.

Jason Kellahin has been appointed New Mexico's official representative on the Interstate Oil Compact Commission. Kellahin is a Santa Fe attorney and former member of the State Corporation Commission. He succeeds **Hiram Dow,** who helped establish the compact and has been the state's official representative on the commission since the compact was adopted in 1935.

Loyd Thompson, assistant superintendent of the mechanical division at Continental Oil Co.'s Ponca City, Okla., refinery, has been named general maintenance engineer in the manufacturing department. Thompson's appointment was followed by five other personnel changes. **G. W. Willoughby,** mechanical superintendent, was named to succeed Thompson as assistant superintendent of the mechanical division. **Roy E. Kennedy,** general-craft supervisor, will succeed Willoughby. **Dale M. Tague,** formerly division engineer for the catalytic cracking division, moved up to replace Kennedy. **S. E. Hickerson,** division engineer in the light-oil division, was appointed division engineer in catalytic cracking division, succeeding Tague, and **Johnie Marchesoni** mechanical inspector, replaces Hickerson in the light-oil division.

Personals

W. B. Schnick has been promoted by Magnolia Petroleum Co. from assistant manager to manager of the traffic and shipping department of the company's Beaumont refinery. He replaces **J. D. Hurst,** who retired.

Samuel G. Woinsky has joined Atlantic Refining Co. as a junior development engineer. **Chester B. DeSavigny** has joined the research and development department as junior research chemist.

P. D. Caesar has been appointed manager of the research section of Socony Mobil Oil Co.'s Paulsboro, N. J., laboratory. **S. L. Meisel** has been named assistant supervisor and **George T. Kerr** senior research chemist.

J. H. RICE

J. H. Rice, assistant manager of pipelines for Ohio Oil Co., has been promoted to manager of pipelines. He succeeds **Carl H. Gompf,** who has retired. Rice has been with the company since 1930. He was Wyoming pipeline division superintendent before becoming assistant manager of pipelines in 1954. **Ralph M. Slough,** manager of the pipeline electrical and communications department, has been moved up to succeed Rice as assistant manager of pipelines. Gompf, retiring manager, joined Ohio Oil in 1910. He was appointed pipelines manager in 1953.

Jack A. Taylor, geologist for Magnolia Petroleum Co., has been transferred from the company's subdistrict office in Lake Charles, La., to Mount Vernon, Ill., and promoted to district geologist in charge of the Illinois district.

George T. Goggin, executive vice president of Douglas Oil Co. of California, has been reelected president of the Independent Refiners Association of California, Inc. **Morton A. Sterling,** executive vice president of Sunset Oil Co., has been elected vice president and **Richard Curtis,** Wilshire Oil Co., secretary - treasurer. New directors of the association are **Newcomb D. Taylor,** secretary - treasurer, Hancock Oil Co., **A. M. Lockhart,** president of Envoy Petroleum Co., and **John Rothschild,** Rothschild Oil Co.

J. Durwood Pate, Oklahoma City district geologist with Eason Oil Co., has resigned to become an independent geologist there.

E. I. Grizzell has been named supervisor of Independent Exploration Co. in Houston. Grizzell has been with Independent Exploration since 1937.

Robert M. Hippard, division exploitation engineer for Shell Oil Co. in Odessa, Tex., has been transferred to New Orleans as exploitation engineer.

Donald L. McCall has joined Magnolia Petroleum Co. as junior petroleum engineer in Pampa, Tex. McCall recently was discharged from the Army.

Merrill Nielsen, geologist with United Manufacturing Co. in Owensboro, Ky., has joined Sinclair Oil & Gas Co. in Grand Junction, Colo.

J. S. Crump, district foreman with Interstate Oil Pipe Line Co., has been transferred to Rodessa, La., from Oxford, La.

R. W. Lovell, foreman for The Texas Co. in Drumright, Okla., has been promoted to Panhandle district foreman at Liberal, Kans.

Tom Rasmussen has resigned from Pure Oil Co. after 5½ years in the district production office in Midland, Tex., to become an independent oil operator in Midland.

J. O. Horning has joined American Liberty Oil Co.'s Mount Pleasant, Tex., refinery as chief chemist. Horning was formerly chief chemist with Ralph M. Parsons Co. in Batman, Turkey. Parsons built a refinery in Batman for Turkish Petroleum Co.

Alvin J. Schisler and **Herman J. Schmalz** have joined Rupnik & Ballou, Tulsa exploration consultants. Schisler was formerly party chief for Exploration Consultants, Inc., in Canada. Schmalz was party chief in Kansas and Oklahoma with Geophysical Consultants, Inc. Rupnik and Ballou specializes in integration of seismic and geologic data.

Ernest F. Semrad, Michigan Wisconsin Pipe Line Co.'s assistant engineer, has been appointed assistant chief engineer of Michigan Wisconsin and its affiliate, American Louisiana Pipe Line Co. Semrad joined Michigan Wisconsin in 1949. **James J. Trebilcott,** admintrative assistant to the manager of operations of Michigan Wisconsin, has been named assistant manager of operations.

Tyler Brinker, drilling engineer with Union Oil Co., has been transferred to Abbeville, La., from Houston.

W. R. Greene, district production engineer with Shell Oil Co., has been transferred to Midland, Tex., from Hobbs, N. M.

A. E. C. Drake, C. E. Spearing, and **Duncan Anderson** have been elected directors of BP Trading, Ltd., sub-

A. E. C. DRAKE

C. E. SPEARING

sidiary of British Petroleum Co. Drake was general manager for British Petroleum in Iran and Iraq before being appointed manager of supply in 1956. Spearing has been BP general manager of refineries since 1943. Anderson is chief accountant.

Sidney S. Galpin, production engineer with New York State Natural Gas Corp., has been transferred to Luthersburg, Pa., from Jeannette, Pa.

William E. Franklin has joined Cities Service Oil Co. as engineer trainee in the Oklahoma City production department.

Luther E. Petty, intermediate petroleum engineer with Pan American Petroleum Corp., has been promoted to plant engineer and transferred to Robstown, Tex., from Tulsa.

J. J. Donovan, associate research chemist with Houdry Process Corp., has been promoted to project director. **W. S. Briggs** and **G. Talvenheimo,** assistant research chemists I, have moved up to associate research chemists. **J. E. McEvoy,** assistant research chemist II, has been named assistant research chemist I.

P. L. Robison, assistant manager of Atlantic Refining Co.'s Port Arthur, Tex., refinery, has been named manager. He replaces **Robert Stewart,** who has retired. Robison has been with Atlantic since 1926. He was appointed assistant manager at Port Arthur in 1942. **B. E. Milner,** technical assistant to the manager at Port Arthur, has been appointed general superintendent of the refinery. Milner joined Atlantic in 1939.

Personals

Donald Lee Frazee, geologist with Sinclair Oil & Gas Co., has been transferred to Lafayette, La., from Houston.

Dr. H. C. G. Knipscheer, formerly with Imperial Oil, Ltd., in Calgary, has joined Alex McCoy Associates, Inc., as a geologist in Calgary.

Thomas J. Jeffrey has resigned as a petroleum engineer for James A. Lewis Engineering, Inc., Dallas, to set up consulting offices in Dallas specializing in reservoir engineering, secondary recovery, and valuation and management of oil properties. Jeffrey had been with the Lewis firm since 1954. Prior to that he was division engineer at Tulsa for Atlantic Refining Co.

Joe L. Barthel, assistant district superintendent for Carter Oil Co. at Purcell, Okla., has been named district superintendent. He succeeds **Foster Precise,** who has retired.

John V. Crable and **William C. Stewart** have joined Gulf Research & Development Co.'s production engineering division.

S. R. Knapp, tool pusher with Falcon Seaboard Drilling Co., has been transferred to Elk City, Okla., from McKinney, Tex.

Lawrence G. Cannell has joined Shell Development Co. in the petroleum chemistry department, Emeryville, Calif.

Dr. George F. Kirby, Jr., vice president in charge of research and development for Ethyl Corp., has been elected a director. A graduate of Louisiana College and Louisiana State University, Kirby has been with Ethyl since 1940.

E. B. Shade, district geologist in San Antonio, Tex., for Ohio Oil Co., has been named assistant division geologist in Casper, Wyo. **William L. Skipp,** geologist, formerly in Cody, Wyo., has also been transferred to Casper.

R. W. Mallory of Champlin Refining Co. in Casper, Wyo., has been elected president of the American Association of Petroleum Geologists, Rocky Mountain section. Other officers are **Gregory Elias,** Gulf Oil Corp., Durango, Colo., vice president; and **James A. Masterson,** Canada Southern Oils, Inc., Casper, secretary-treasurer.

James F. Donham, district engineer with Sinclair Oil & Gas Co. in Casper, Wyo., has been promoted to assistant district superintendent and transferred to Bairoil, Wyo.

Guy C. Kiddoo, general vice president of the First National Bank of Chicago, and **Robert S. Kerr, Jr.,** associate in the Oklahoma City law firm of Kerr-Conn-Davis, have been elected directors of Kerr-McGee Oil Industries, Inc.

R. S. Wansbrough, petroleum engineer with Delhi-Taylor Oil Corp., has been transferred to Dallas from McAllen, Tex.

P. M. McFadden, district superintendent with Humble Oil & Refining Co., has been transferred to Monroe City, La., from Galveston, Tex.

DEATHS

Lucius E. Ingham, 65, Owensboro, Ky., a director and retired vice president of Texas Gas Transmission Corp., died March 2 in St. Petersburg, Fla. Ingham had retired February 1. He had been in the natural-gas business since 1910 when he joined United Natural Gas Co. in Oil City, Pa. He joined Kentucky Natural Gas Corp., predecessor to T.G.T., in 1939.

William Vorhees, 81, retired oil producer, died February 28 in Elizabethtown, Pa.

Max Davis, Mount Vernon, Ill., drilling contractor, was killed in an auto accident recently.

John W. Brown, 71, retired superintendent of Continental Oil Co.'s Baltimore petrochemical plant, died recently in Denver. Brown, a chemical engineer, retired and moved to Denver in 1938.

William H. Moran, 67, president of E. F. Moran, Inc., Tulsa drilling firm, and retired superintendent of The Texas Co.'s pipeline division, died March 6 in Tulsa. Moran joined The Texas Co. in 1906 and retired in 1948.

George P. Gentry, 62, manager of Phillips Petroleum Co.'s materials department in Bartlesville, Okla., died March 3 in Bartlesville.

We are pleased to announce that

GILBERT H. LA PIERE

(formerly Petroleum-Engineer with

The Chase-Manhattan Bank)

has joined our firm as Manager of our

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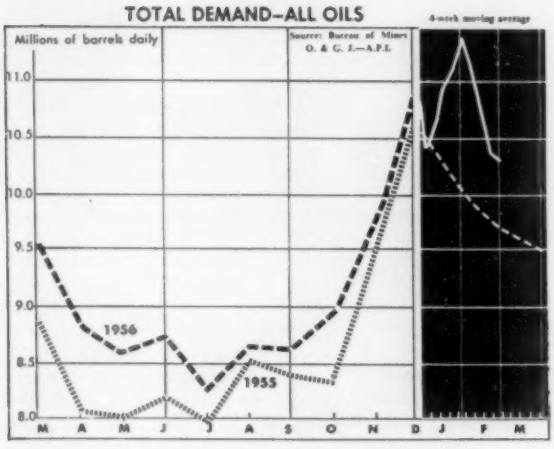
March 1, 1957

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,531,975	DOWN	34,400	UP	245,564
Crude stocks	251,684,000	UP	1,159,000	DOWN	3,782,000
Completions	1,034	UP	185	UP	5
Refinery runs	8,076,000	UP	281,000	DOWN	17,000
Gasoline stocks	203,749,000	DOWN	373,000	UP	8,821,000
Kerosine stocks	21,469,000	DOWN	254,000	UP	2,928,000
Distillate stocks	85,698,000	DOWN	2,040,000	UP	14,050,000
Residual stocks	37,064,000	UP	1,292,000	UP	1,094,000
Four-product stocks	347,980,000	DOWN	1,375,000	UP	26,893,000
Total imports	1,295,200	DOWN	141,800	DOWN	93,000



Product Prices Walk Tight Rope As Spring's First Signs Appear

PETROLEUM product markets are beginning to show some of the signs of spring. An important characteristic of this seasonal indicator is that the early signs are bad.

Warm weather in February cut actual consumption of distillate fuels. Signs of spring will cause the home owner to do a little figuring before ordering another load of heating oil. The calendar tells him that most of winter weather has passed. Also, that final income-tax payments are due in a few days. Both facts will influence his decision on filling his fuel tank again this season.

Sales of heating oil will continue, but individual deliveries will be smaller. Smaller deliveries mean increased costs for the distributor. If he is a private brand distributor, he probably starts hunting for bargains in heating oil. Lower prices at terminals will help him recover some of the extra delivery cost.

Most distributors have started working down their own distillate stocks so that fuel tanks will be near empty at the end of the season. These actions by users and distributors tend to promote softer distillate markets after the end of February.

The trend is showing up in most market areas. Early in January, reports from the Gulf Coast indicated that buyers were offering premiums for distillate delivered as late as the first half of March. Now that March is here, there are no reports of premiums for distillate on the Gulf Coast.

The Group 3 distillate market has shown signs of softness for several weeks. Current prices are about the same as last year, despite the boost in crude cost. The low for spot sales of No. 2 fuel held at 9.25 cents a gallon from early February last year to almost the middle of April. The drop in April was to 9.0 cents a gallon, followed by 8.75 cents about the middle of August. Prices strengthened some in November to 8.875 cents. A gain of 0.25 cent was reported about the middle of December and another 0.125 cent before the end of the month.

The end-of-the-year price for No. 2 on the Group 3 market was about the same as in February. The effect of the crude-price increase was a raise of 0.25 cent a gallon. Some material moved at slightly firmer rates late in January, but the general spot low was back to 9.50 a gallon by the third week of February.

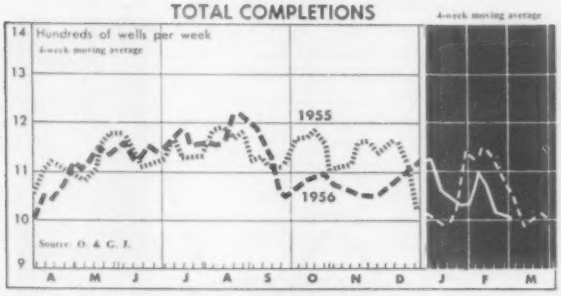
Some formal quotations for Group 3 No. 2 still hold at 9.50 cents, but enough material is selling at 9.25 cents to definitely establish the lower price.

Demand for residual fuel is still good on the Gulf Coast, but the trend is away from the premiums paid during December and January. Some of the current offers for resid in the Mid-Continent to be shipped to the Gulf Coast would net the refiner about $2.20 a barrel. This is well below the $2.50 a barrel received for material in January.

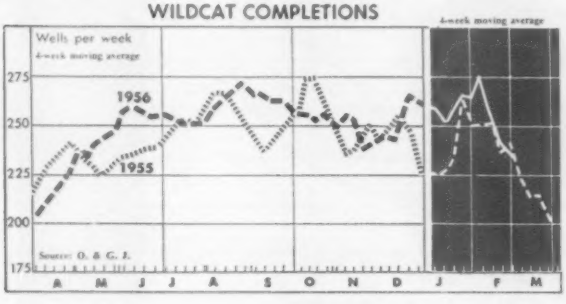
Changes in motor-fuel demand may not strengthen gasoline prices for another 2 months, but the shift to spring grade has cut natural-gasoline prices.

Grade 26-70 natural on the Breckenridge market dropped 0.5 cent a gallon on March 1 to 4.0 cents. The same cut on the Group 3 market came the next day. Current prices are 1.0 cent a gallon below quotations at this time last year.

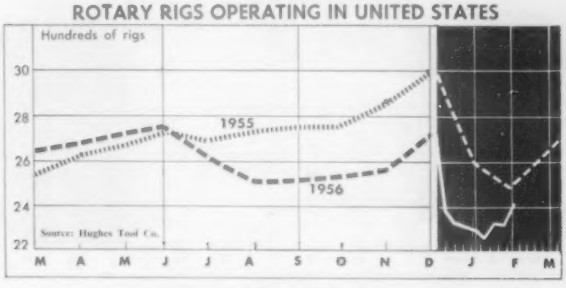
TOTAL COMPLETIONS



WILDCAT COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



ACTIVE ROTARY RIGS*

Area—	3-4-57	2-25-57	3-5-56
North Central and East	78	84	88
Southeast	36	32	33
Okla., Kans., Ark., Mo.	423	401	491
Louisiana	438	451	412
North and East Texas-Panhandle	396	367	442
Gulf Coast and South Texas	232	229	286
West Texas-New Mexico	500	465	533
Rocky Mountain	210	199	212
Pacific Coast	96	98	133
Total United States	2,409	2,326	2,630
Western Canada	244	254	226

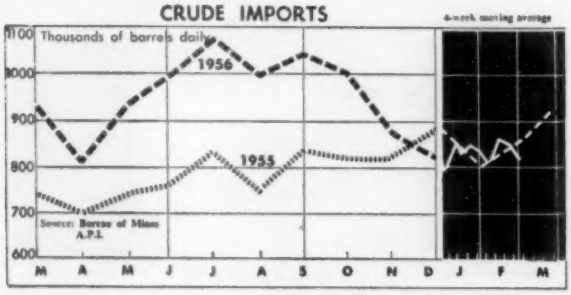
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 2, 1957

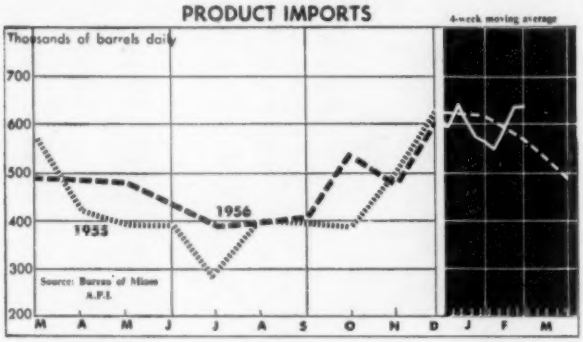
	Total of all wells							Wildcat completions and discoveries									
						Cum.							Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Fla.	*5	3	0	2	51,040	11	18	0	0	0	2	2	0	0	0	5	5
Arkansas	13	10	0	3	37,583	177	111	1	0	0	0	1	4	0	0	22	26
California	50	32	2	16	223,920	358	350	3	0	0	13	16	7	0	2	87	96
Colorado	29	8	2	19	163,574	204	209	1	0	1	16	18	6	0	3	127	136
Illinois	50	26	0	24	98,086	431	655	1	0	0	11	12	7	0	0	94	101
Indiana	13	6	0	7	18,961	118	108	0	0	0	4	4	3	0	0	19	22
Kansas	93	45	3	45	329,846	732	836	3	0	1	8	12	24	0	4	103	131
Kentucky	23	6	6	†11	32,639	253	312	0	0	0	5	5	7	0	1	50	58
Louisiana	74	32	16	26	616,281	651	710	0	0	0	7	7	16	4	17	74	111
North	22	9	4	9	97,404	254	258	0	0	0	3	3	2	0	2	27	31
South	29	9	8	12	306,901	288	359	0	0	0	2	2	8	4	13	41	66
Offshore	23	14	4	5	211,976	109	93	0	0	0	2	2	6	0	2	6	14
Michigan	7	4	0	3	25,103	67	90	0	0	0	2	2	3	0	0	25	28
Mississippi	8	4	0	4	74,014	53	77	1	0	0	4	5	4	0	0	21	25
Montana	6	2	0	4	50,138	54	68	1	0	0	2	3	2	0	0	18	20
Nebraska	13	7	0	6	80,884	134	155	0	0	0	2	2	7	0	0	69	76
New Mexico	32	19	6	7	129,368	341	334	1	1	0	3	5	14	1	4	39	58
Northwest	8	0	6	2	31,654	124	119	0	1	0	2	3	6	1	3	11	21
Southeast	24	19	0	5	97,714	217	215	1	0	0	1	2	8	0	1	28	37
North Dakota	9	4	0	5	57,354	60	40	1	0	0	5	6	4	0	0	21	25
Ohio	33	21	5	‡7	71,425	178	194	0	0	0	0	0	0	0	0	3	3
Oklahoma	125	74	2	§49	430,059	1,184	1,514	3	0	1	8	12	23	3	1	109	136
Pennsylvania-New York	4	0	4	0	16,726	49	137	0	0	1	0	1	0	0	6	12	18
Texas	428	251	27	150	1,519,628	3,857	3,651	10	0	4	97	111	126	5	44	924	1,099
Southwest (1 & 4)	52	17	3	32	231,003	456	527	2	0	0	20	22	17	2	14	149	182
Gulf Coast (2 & 3)	80	36	13	31	333,378	468	467	1	0	2	21	24	12	0	22	134	168
East (5 & 6)	22	11	3	8	126,034	227	219	1	0	1	7	9	4	0	1	62	67
N. Central (7-B & 9)	145	82	1	62	284,354	1,432	1,245	5	0	0	38	43	63	0	2	430	495
West (7-C & 8)	93	78	1	14	415,531	1,004	989	1	0	1	9	11	28	0	4	129	161
Panhandle (10)	36	27	6	3	129,328	270	204	0	0	0	2	2	2	3	1	20	26
Utah	2	2	0	0	11,134	24	14	0	0	0	0	0	3	0	0	9	12
West Virginia	8	2	6	0	21,156	117	113	0	0	0	0	0	0	0	6	2	8
Wyoming	8	4	1	3	31,540	137	138	0	0	1	1	2	7	0	2	42	51
Miscellaneous (S. D.)	1	0	0	1	6,770	15	45	0	0	0	1	1	0	0	1	8	9
Total United States	**1,034**	562	80	392	4,097,229	9,205	9,879	26	1	9	191	**227**	267	13	91	1,883	2,254
Total previous week	849	470	78	301	3,642,072	....	....	24	1	11	152	188	241	12	82	1,692	2,027
Total Mar. 3, 1956	1,029	532	71	426	4,406,325	....	....	24	0	7	224	255	291	28	67	1,870	2,256
Cumulative 1957	9,205	4,936	671	3,598	37,886,936	....	....	....	....	....	....	....	....	....	....	....	....
Western Canada	57	34	5	18	265,878	398	....	0	0	1	14	15	5	0	7	85	97

*Florida 1 dry, 5,501 ft. Service wells included: †3, ‡2, §10.

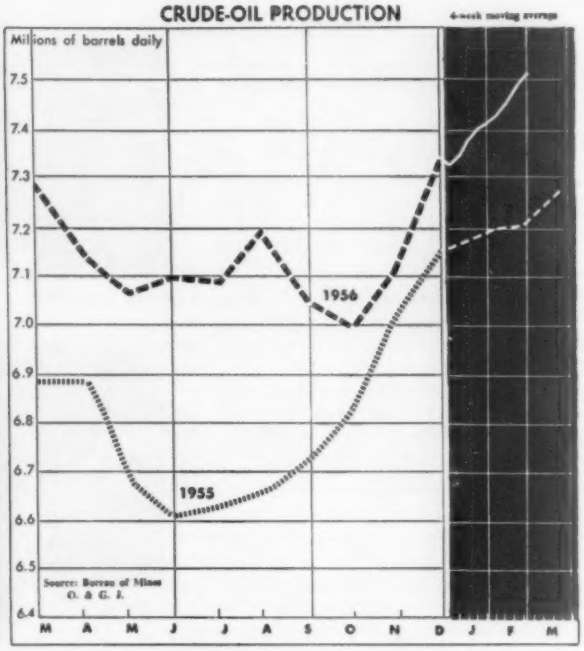
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

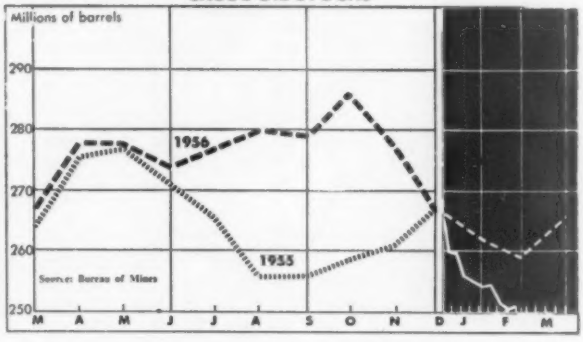


DAILY AVERAGE PRODUCTION FOR WEEK

	March 2, 1957			Feb. 23
	Crude oil	Lease condensate	Total	total
Alabama	11,700		11,700	11,300
Arkansas	80,650	450	81,100	81,100
California	936,800		936,800	937,700
Colorado	158,350		158,350	159,000
Eastern	50,400		50,400	49,900
Florida	1,250		1,250	1,250
Illinois	233,900		233,900	234,900
Indiana	32,200		32,200	32,800
Kansas	†342,350		†342,350	†363,100
Kentucky	50,300		50,300	50,400
Louisiana	899,700	77,800	977,500	976,000
North	128,700	2,800	131,500	130,000
South	771,000	75,000	846,000	846,000
Michigan	27,100		27,100	26,800
Mississippi	107,550	5,200	112,750	112,750
Montana	71,850		71,850	70,400
Nebraska	38,650		38,650	38,650
Nevada	100		100	100
New Mexico	253,300	4,975	258,275	258,225
North Dakota	39,700		39,700	39,100
Oklahoma	†659,950		†659,950	†675,100
Texas	3,074,000	56,350	3,130,350	3,130,350
Dist. 1	56,000	525	56,525	56,525
Dist. 2	152,000	8,950	160,950	160,950
Dist. 3	432,000	26,500	458,500	458,500
Dist. 4	238,000	6,500	244,500	244,500
Dist. 5	42,000	500	42,500	42,500
Dist. 6	138,000	6,350	144,350	144,350
East Texas Field	214,000		214,000	214,000
Dist. 7-B	165,000	100	165,100	165,100
Dist. 7-C	171,000	4,400	175,400	175,400
Dist. 8	1,156,000	1,425	1,157,425	1,157,425
Dist. 9	212,000	825	212,825	212,825
Dist. 10	98,000	275	98,275	98,275
Utah	12,900		12,900	10,950
Wyoming	304,400		304,400	306,200
Others	‡100		‡100	‡100
Total U. S.	7,387,200	144,775	**7,531,975**	7,566,375
Change from prev. week, down			**34,400**	
Canada	†525,800		†525,800	†562,197
Total U. S. production, Jan. 1-March 1			455,037,550 bbl.	
Same period last year (crude plus cond.)			*446,759,832 bbl.	

*Includes 7,948,240 bbl. condensate. †Week ended previous Monday. ‡S. Dakota.

CRUDE-OIL STOCKS



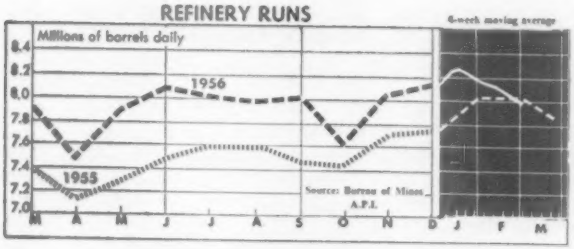
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

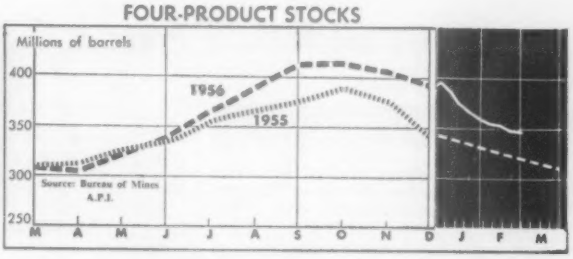
	2-23-57	2-16-57	2-25-56
Pennsylvania Grade	2,503	2,284	2,716
Other Appalachian	2,045	2,065	1,927
Illinois, Indiana, Michigan	9,783	10,071	9,452
Nebraska, North Dakota	1,988	2,192	2,055
Kansas	9,343	9,188	7,933
Oklahoma	20,535	20,955	22,594
Arkansas	2,405	2,279	2,198
Louisiana	18,902	18,903	16,667
North	2,748	2,825	2,493
South	16,154	16,078	14,174
Mississippi	2,093	2,061	2,938
New Mexico	7,319	7,423	8,166
Texas	114,604	112,685	120,267
East Texas proper	10,420	9,861	9,648
West Texas	54,229	52,886	59,092
Texas Gulf	20,942	21,399	21,611
Other Texas	29,013	28,539	29,916
Wyoming	16,030	15,518	15,033
Other Rocky Mountain	5,902	6,028	5,220
California	26,915	27,475	27,069
Foreign	†11,317	11,298	11,231
Total	251,684	250,525	255,466

*Bureau of Mines. †Includes 2,701,000 bbl. in California.

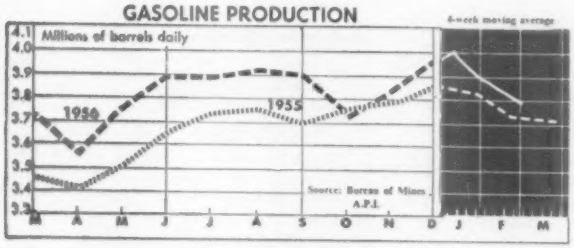
REFINERY RUNS



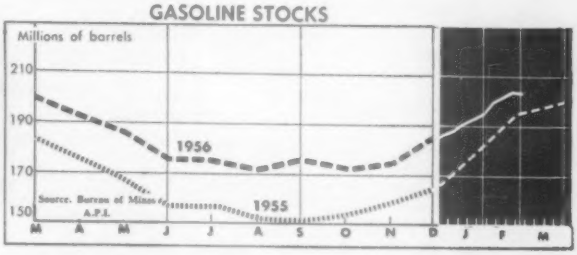
FOUR-PRODUCT STOCKS



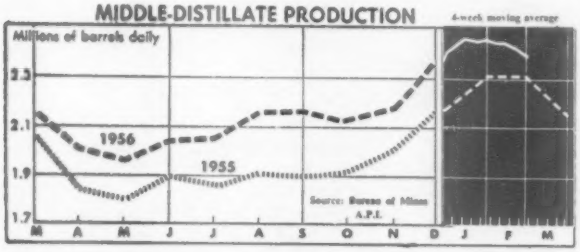
GASOLINE PRODUCTION



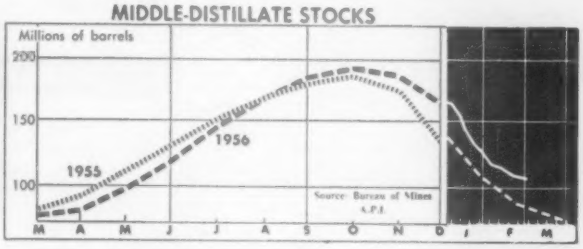
GASOLINE STOCKS



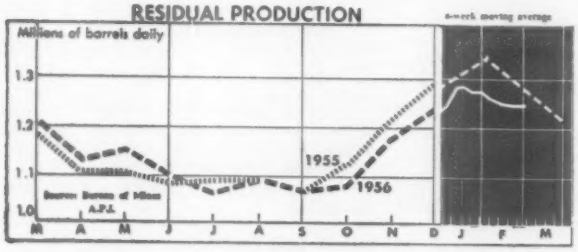
MIDDLE-DISTILLATE PRODUCTION



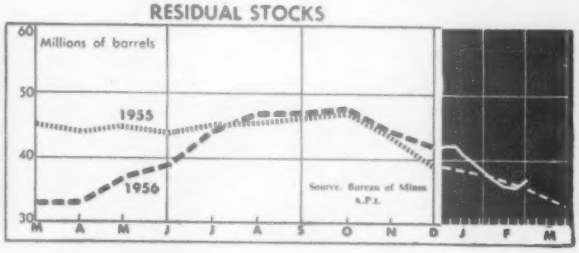
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MARCH 1, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,171	514.3	40.7	339.9	215.4	41,719	9,147	28,881	9,266	1,147	447.1	36.6	287.6	217.9
Appalachian:														
District 1	105	44.3	6.8	22.3	7.1	5,101	482	2,161	307	92	34.3	4.0	21.6	7.9
District 2	114	62.4	11.4	18.0	15.7	3,202	410	765	349	104	50.7	7.3	18.7	15.4
Ind., Ill., Ky.	1,481	697.4	83.0	323.7	200.6	37,082	3,963	12,801	4,364	1,394	704.1	74.5	287.3	184.9
Minn., Wis., Dak.	99	49.2	5.9	28.0	8.1	7,017	558	4,195	282	82	39.0	7.0	22.8	6.4
Okla., Kans., Mo.	681	385.7	12.3	176.4	47.0	20,575	793	8,138	1,006	666	372.5	18.4	159.4	35.3
Inland Texas	269	186.4	5.9	54.0	21.2	8,777	282	1,253	1,794	270	192.4	5.8	55.1	22.2
Texas Gulf Coast	1,950	852.3	120.8	557.3	244.3	27,832	2,622	8,737	5,265	1,983	902.3	113.5	529.9	251.3
La. Gulf Coast	664	328.6	60.6	199.1	57.7	12,242	1,884	4,550	1,796	713	344.6	58.7	173.2	52.9
N. La. and Ark.	101	34.6	6.1	28.6	7.3	5,404	737	2,230	193	71	24.1	4.3	17.3	3.2
Rocky Mountain:														
New Mexico	28	14.1	0.6	4.7	3.1	457	13	98	64	21	10.8	0.4	3.7	2.7
Other Rocky Mtn.	283	131.3	3.6	62.9	39.2	7,719	285	2,329	998	262	125.2	5.5	63.4	39.5
California	1,130	517.0	0.3	210.1	357.9	26,622	293	9,560	11,380	1,109	487.0	5.6	167.9	373.9
Mar. 1, 1957	8,076	3,817.6	358.0	2,025.0	1,224.6	203,749	21,469	85,698	37,064	7,914	3,734.1	341.6	1,807.9	1,213.5
Feb. 22, 1957	7,795	3,667.6	331.1	1,979.7	1,235.9	204,122	21,723	87,738	35,772	.....	.....	.....	.....	.....
Mar. 2, 1956	8,093	3,733.1	386.7	1,886.9	1,260.9	194,928	18,541	71,648	35,970	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (88 octane)	12.00-12.25
Premium (96 octane)	13.75-14.00
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	11.25-11.50
Regular (92 octane)	11.50-11.75
Premium (97 octane)	13.25-13.50
Premium (98 octane)	13.50-14.00
California (rack):	
Regular (84 octane)	13.1
Premium (93 octane)	14.1
Premium (96 octane)	15.1
Caribbean area (cargoes):	
Regular (87 octane)	11.00
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
★ Grade 26-70	4.5
Breckenridge:	
★ Grade 26-70	4.0

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
★ Kerosine 42-44	10.25-10.50
★ Diesel oil (58 d.i. and above)	9.875-10.125
★ Distillate No. 1	9.875-10.125
★ Distillate No. 2	9.25-9.50
Gulf Coast (cargoes):	
Kerosine 41-43	10.75-11.00
Distillate No. 2	10.25-10.50
New York Harbor (barges):	
Kerosine 41-43	12.25
Distillate No. 2	11.65
Diesel fuel, 48-52 d.i.	11.95
Caribbean area (cargoes):	
Distillate No. 2	10.25

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$2.40-2.50
Gulf Coast (cargoes):	
Bunker C fuel	$2.75-3.00
New York Harbor (barges):	
Bunker C fuel	$3.30-3.40
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.75-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, most of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, Jenuary 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	**3.15**
Canada:	
Leduc-Woodbend (flat prices D-2), D-3)	2.78
Redwater (Alta.) D-3	2.67
Smiley-Viking (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 40°-40.9°, Puerto La Cruz	3.37
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
Iranian, 34.0°-34.9°, Bandar Mashur	1.91
Iranian, 34.0°-34.9°, Abadan	1.86
Iraq, 36.0°-36.9°, Fao	1.87
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.72
Qatar, 39.0°-39.9°, Umm Said	2.06
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

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(Latest reported spot fixtures)

★ N.W.I.-U.S.N.H., dirty (USMC +185%)	$7.70
★ Gulf-France, clean (Scale+315%) (163s. 7d.)	22.88
★ P.G.-France, dirty (Scale+280%) (306s. 3d.)	42.83
★ P.G.-Japan, dirty (USMC+195%)	26.55

SUPPLY AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

GASOLINE

	Total demand	Refinery production	Stocks end of period†
February 1957*	3,600	3,790	203,750
January 1957*	3,680	3,904	195,910
December 1956	3,642	3,986	187,271
March 1956	3,738	3,734	199,698
February 1956	3,440	3,745	196,092

KEROSINE

February 1957*	472	359	21,470
January 1957*	595	376	24,760
December 1956	477	379	31,420
March 1956	395	342	17,215
February 1956	481	385	18,712

DISTILLATE

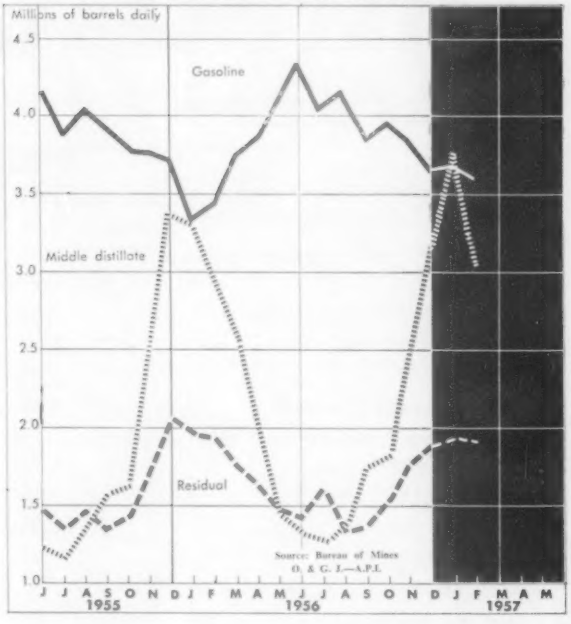
February 1957*	2,570	2,029	85,700
January 1957*	3,160	2,076	101,240
December 1956	2,566	1,981	133,981
March 1956	2,173	1,808	60,846
February 1956	2,450	1,918	71,335

RESIDUAL

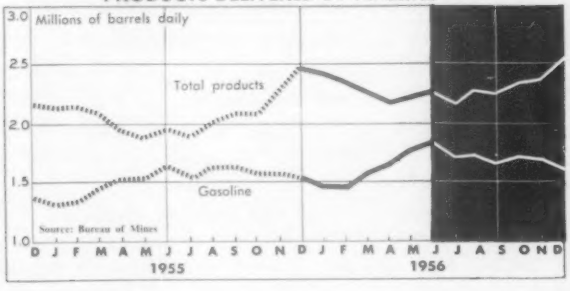
February 1957*	1,922	1,243	37,060
January 1957*	1,950	1,270	38,400
December 1956	1,869	1,288	44,491
March 1956	1,754	1,214	32,984
February 1956	1,932	1,286	35,673

*Preliminary. †Thousands of barrels.

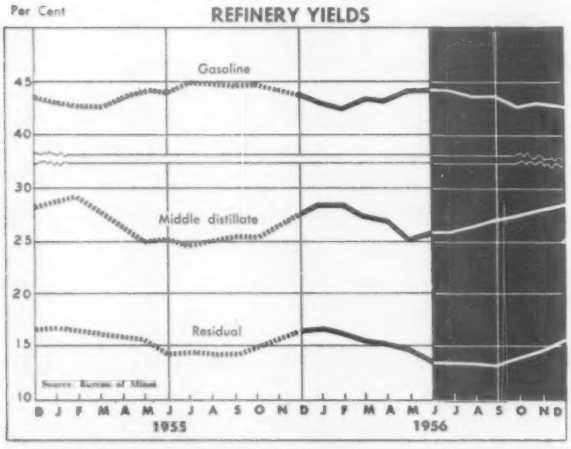
TOTAL DEMAND–MAJOR PRODUCTS



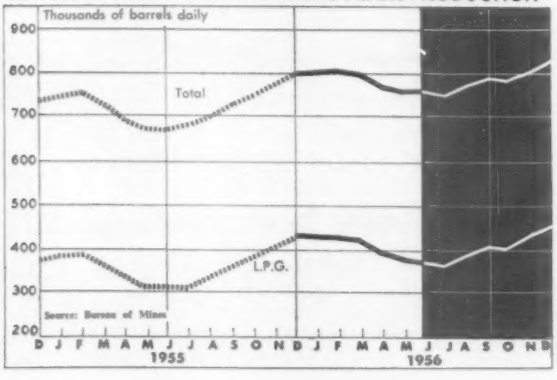
PRODUCTS DELIVERED BY PIPELINE



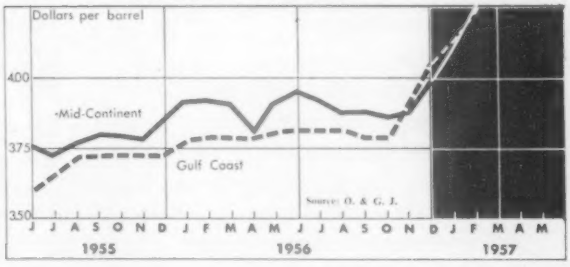
REFINERY YIELDS



NATURAL-GASOLINE AND CYCLING PLANT PRODUCTION



REFINERY REALIZATION



REFINERY REALIZATION

	Feb.* 1957	Jan.* 1957	Dec. 1956	Feb. 1956
Mid-Continent	$4.28	$4.14	$3.95	$3.92
Gulf Coast	4.25	4.15	3.98	3.78

*Preliminary.

Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel oil, and residual as published in The Oil and Gas Journal.

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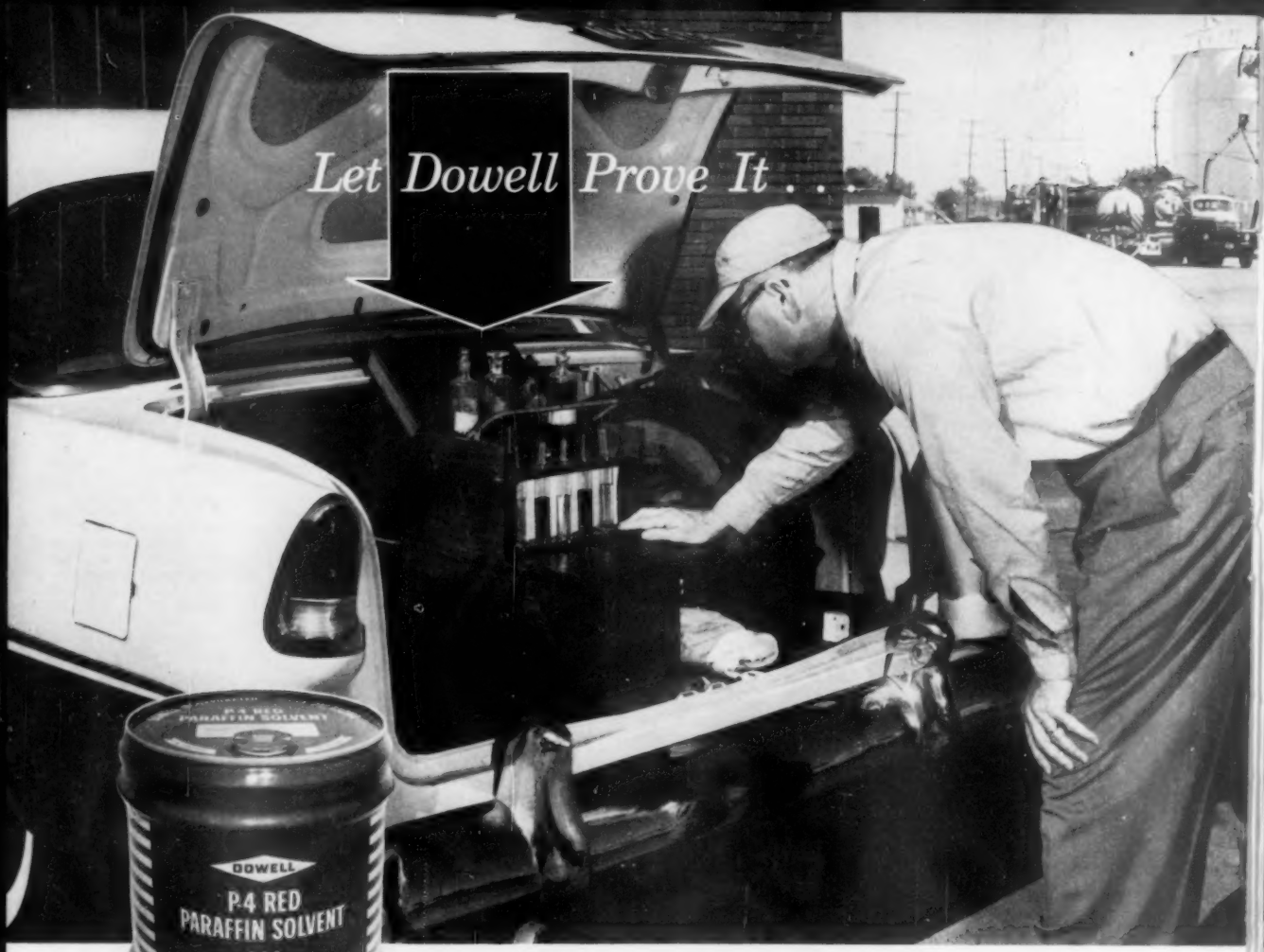

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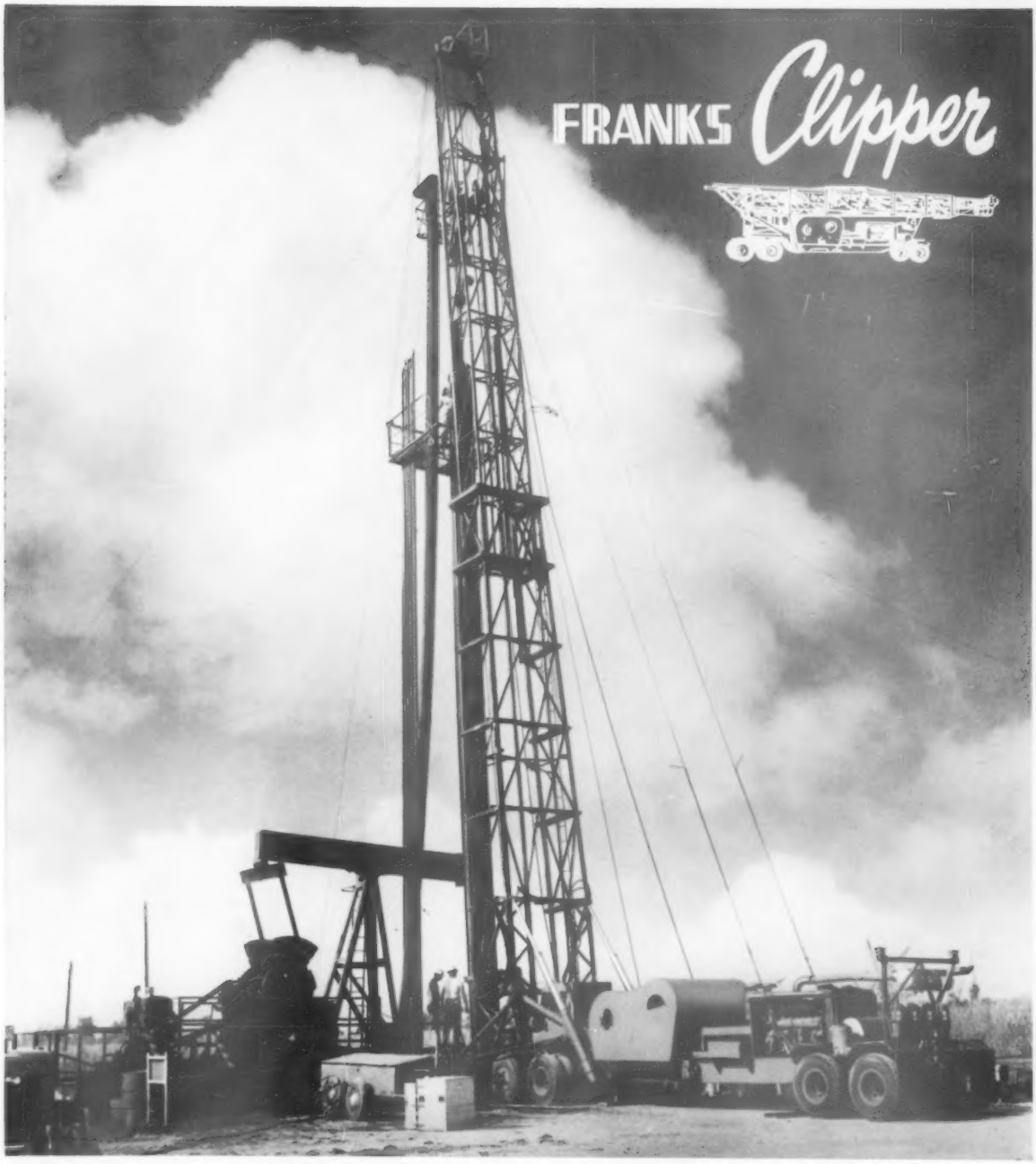

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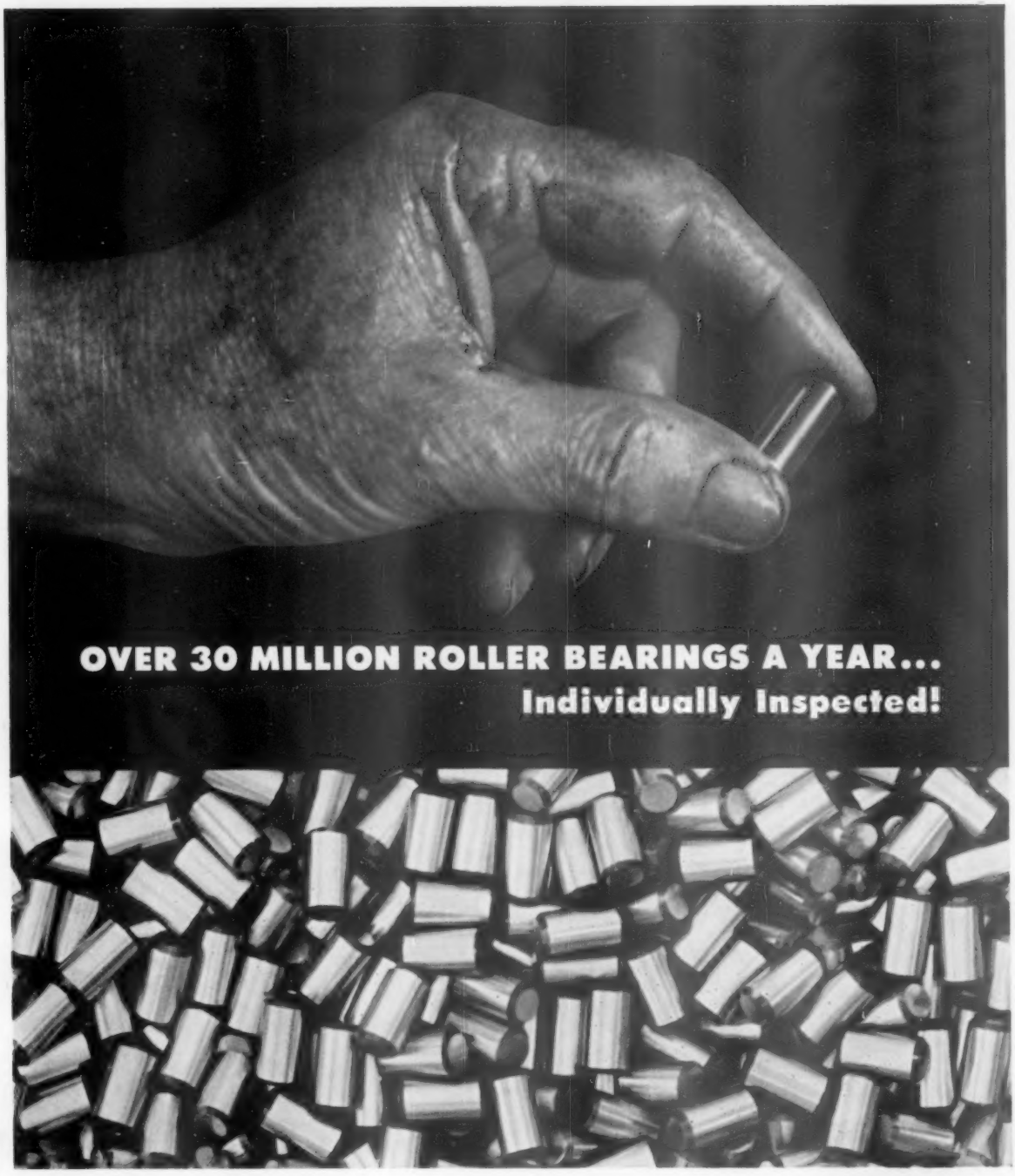

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